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AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

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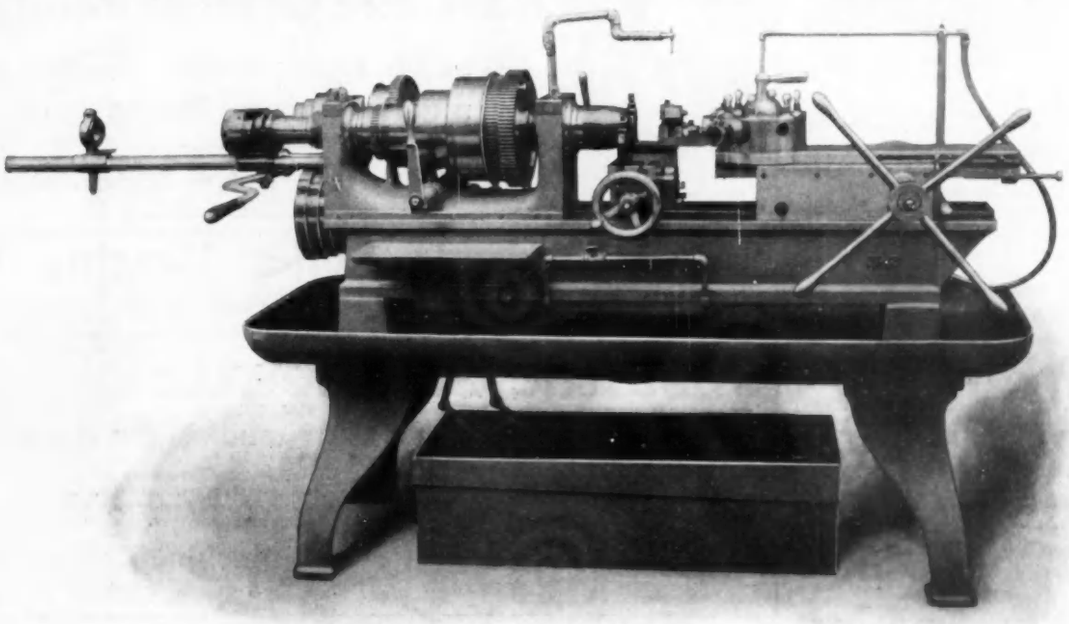

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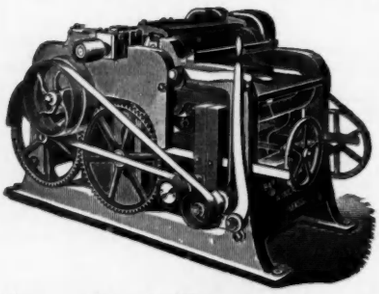

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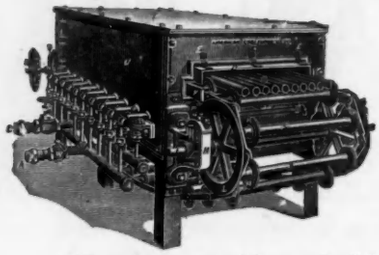

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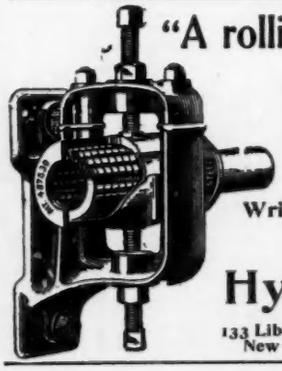

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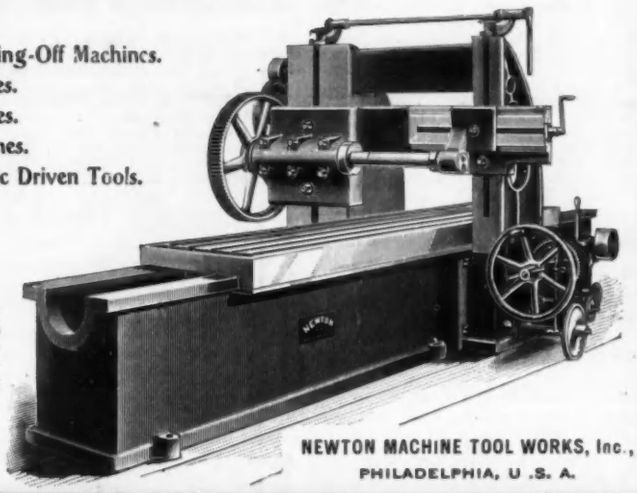

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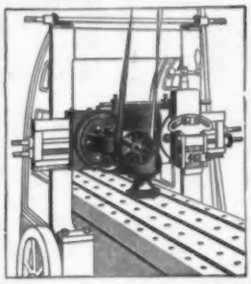

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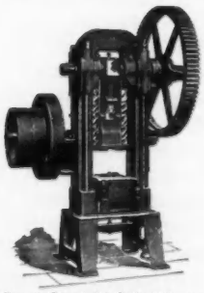

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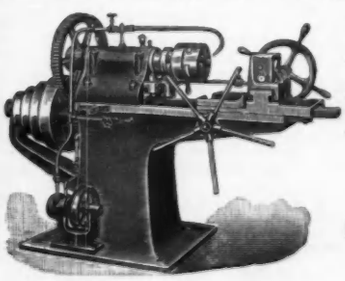

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AMERICAN MACHINIST

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The Reasons for Quitting.

We know of shops where they might be much better off if the superintendent or the proprietor would interview every man leaving his employment and draw from him, if possible, a frank statement of the real reason or reasons for his quitting. And it would be the duty of the men to tell him the real reasons without reserve.

There are shops that find it difficult to keep good men. They drift from bad to worse and finally their proprietors conclude that good men are no longer obtainable, and give up all idea of ever getting any of them.

They understand more or less thoroughly that conducting a machine shop is primarily a mechanical enterprise; that what they have to sell is the product of mechanical skill—the difference between pig iron and steel bars and finished, operative machines. They know that in order to sell the product of this skill they must first employ the skill; but when they have difficulty in continuously employing skilled men they often take no measures to find out why they have such difficulty, and the reason remains a mystery to them. They pay as good wages as other shops do, perhaps; have as good and pleasant shops in which to work, and are supplied with good equipment; yet men come and go, and seem always to be going faster than they come. Men do not continuously and unanimously leave a shop unless there is some reason for it; but in most cases they do not state these reasons to those who would be most benefited by knowing them.

It ought to be obvious that unnecessarily disagreeable features about a shop should be avoided. The best men can usually find employment in shops where these features are absent, and will inevitably do it. If, for instance, there is a "mean" foreman, one who seems to hate his men and treat them as though they all intended to be thieves and swindlers, and would be but for his vigilance; who brow-beats them and discourages thinking among them, the superintendent or proprietor should know it; but he stands precious little chance of doing so unless someone tells him about it. For this reason a frank statement made by each departing man would often result in great benefit both to the shop and to the men who work in it.

Interstate Trade and Encouragement of Manufacture.

Mr. T. H. Martin, editor of our contemporary, "Dixie," in an address delivered before the Georgia State Agricultural Society recently, said: "I wish it were possible to pass a law that would prevent the sale of Georgia products beyond the borders of the State until they were manufactured into usable articles and ready for the consumer. Such a law would be a real blessing, for it would guarantee employment to an army of sturdy wage-earners, and the daily needs of these men would in turn establish a local market for varied farm products; then the great economic wheel would be complete. All interested would prosper, because all would have a distinct mission to perform."

It ought to be generally understood that the principle involved in this wish of Mr. Martin is one that has been thoroughly discredited. It is all well enough to encourage manufactures and diversity of occupations; but this should be done along natural lines of development; that is to say, each movement made tending in this direction should be made, because that particular movement at that time offers a prospect of profit to him who undertakes it; but to bring about a condition of this kind by a repression or a forced constrainment of the lines of trade has always proved injurious, has led to more wars and other troubles than any other one cause, perhaps, on the face of the earth, and will always produce far more harm than it can possibly produce good. The principle carried to its logical conclusion would, after having been established, say, in the State of Georgia, extend also to the individual counties of Georgia, and we should find in them men wishing to pass laws preventing any other than manufactured goods going out of any particular county, after which there would be laws enacted by municipalities preventing the shipment of raw material from them, and in the end we should have each small ultimate political division of the country doing its own agricultural work and also all its own manufacturing, and we should lapse into the condition of the aborigines who carried on their affairs in just exactly that way.

There can be little doubt that the particular provision of the American Constitution that has done most for the development of this country in every way is that clause which prohibits any State from passing laws interfering with trade between the States, and when a man wishes that such a law could be enacted he is simply expressing a wish to take a long step backward toward barbarism. Of course Mr. Martin does not really wish to take such a step.

Opening of the Atbara Bridge.

The Atbara bridge, the contract for which was secured by the Pencoyd Iron Works, of Philadelphia, and the material prepared and shipped in so short a time as to astonish the engineers of the Old World, as has been told in our columns, has been transported to the heart of Africa and erected there with consistent celerity, the bridge being formally opened on August 26. No better commentary upon the entire achievement could be desired than that contained in the speech at the opening by the Sirdar, Lord Kitchener, of Khartoum. He said:

"The construction of this magnificent bridge, I think, may fairly be considered a record achievement. So far as the failure of the efforts to place the construction order in England is concerned, I think it

demonstrates that the relations between labor and capital there are not sufficient to give confidence to the capitalist and to induce him to take the risk of establishing up-to-date workshops that would enable Great Britain to maintain her position as the first constructing nation in the world.

"But as Englishmen failed, I am delighted that our cousins across the Atlantic stepped in. This bridge is due to their energy, ability and power to turn out works of magnitude in less time than anybody else. I congratulate the Americans on their success in the erection of a bridge in the heart of Africa. They have shown real grit far from home, in the hottest month of the year, and depending upon the labor of foreigners."

Some of our transatlantic competitors are trying to find comfort in suggestions that the bridge may prove in some respects defective. The "Evening News," of London, says: "It now remains to be seen whether the bridge, built in America, on lines condemned by British engineers, will be able to stand the Atbara's rushing floods." The floods, of course, can attack only the piers and abutments, which were not built in Philadelphia, and we really have built so many bridges as to have full confidence in the success and endurance of our work.

"A Forgotten Steam Engine."

In the latest received issue of "The Engineer," London, we find an editorial bearing the above title which is of more than ordinary interest to the steam engineer. We take pleasure in reproducing the essential portions of the article, and commend it to the special attention of our readers.

"Those who have studied James Watt's life and works know that he left very little to be learned as to the principles on which a steam engine should be made. In his day the science of thermo-dynamics did not exist as we understand it. But for all practical purposes it may, for the steam engine, be summed up in a sentence—'Keep the cylinder hot.' All the science in the world cannot tell us more than that. Watt perfectly understood, moreover, what was to be had from expansion. It is difficult, indeed, to mention any factor likely to promote the economy of the steam engine, whose existence Watt did not recognize, and whose value he did not appraise. He invented and patented the steam jacket, and he did more than this. A defect of the jacket is that while the surface to be kept hot is of almost infinitesimal thickness, the heat derived from the steam in the jacket has to pass through the metal of the cylinder liner, and the result is that the incoming and expanding steam as a rule comes in contact with metal colder than itself, and so condensation takes place. To prevent this it is necessary that the steam in the jacket should be at temperature considerably higher than that of the steam in the cylinder, a condition which can only be secured by superheating the jacket steam, or using steam of a much greater pressure than that in the cylinder.

"Now, James Watt cut the Gordian knot and disposed of the whole difficulty by inventing an engine in which the cylinder is jacketed inside instead of out. Very soon after he had invented his first, or atmospheric, engine, he saw that the cold air following up the piston must cool the cylinder. He shut up the cylinder in a little house of its own, which he kept filled with steam of high pressure, and he patented this steam engine in 1769, that is to say, 130 years ago, and he then gave the world the most perfect steam engine which, from the thermal efficiency point of view, it is possible to construct.

"A single-acting, open-topped vertical cylinder stands inside another. If we stand a small tumbler on a table, and turn a large tumbler upside down over it we have the whole arrangement. The inner cylinder is fitted with a piston, the rod of which passes through a stuffing-box in the top of the outer cylinder. A couple of valves put the inner cylinder alternately in communication with the space between the two cylinders and with a jet condenser. In working, the outer cylinder is always filled with boiler steam. It is, indeed, an extension of the boiler in the same sense that the condenser is an extension of the inner cylinder. The piston rod is coupled by a chain and arc head to the working beam; at the other end of the beam are the spear rods and pumps. When at work let us suppose the piston to be indoors, that is to say, at the bottom of the cylinder; the steam valve opens, steam passes under the piston, balancing the pressure above, and the engine goes out-of-doors by the weight of the spears, and the forcing stroke takes place. Then the steam valve is shut and the exhaust valve opened, and a vacuum is made under the piston which comes indoors, and so on. The steam under the piston could be cut off at any point which would give suitable expansion. The range was fixed by the usual limits obtaining in the case of a Cornish engine. Because the piston is followed up on its descent by steam of full boiler pressure, the inside as well as the outside of the cylinder must be of the temperature proper to the pressure. The steam entering the cylinder under the piston will undergo no initial condensation after the steam valve is shut; and the expanding steam will continually meet with cylinder walls hotter and hotter than itself. The general result will be that condensation of the working steam—as we shall call it, although this distinction is not quite accurate—is out of the question. A certain amount of liquefaction due to the performance of work will take place, but no deposit of moisture on the sides of the cylinder can result. When the piston is descending the boiler steam will probably find the temperature of the cylinder walls reduced, though even this is doubtful. It may be admitted that a certain quantity of water will be produced—although certain experiments which we have carried out go to show that no condensation which can be measured takes place—as the top of the piston always passes above the top edge of the inner cylinder, any water which would otherwise collect on the piston will be pushed over, and will fall down in the space between the two cylinders, from which it can be drained. It must not be forgotten that when expansion is used a certain volume of steam will always be pushed back again into the boiler during the up-stroke of the piston, but this is of no practical importance if the steam pipe is made large.

"We have here, then, an engine in which there is no initial condensation. The expanding steam starts dry in a dry, hot vessel, instead of beginning to expand with some 20 or 30 per cent. of water mixed with it. No conditions more favorable can be found for expanding steam than those provided by Watt. We must seek for sources of waste in the boiler steam. We have repeatedly pointed out that no matter what the quality of an engine—good, bad or indifferent—all the steam received from the boiler by the cylinder must leave the cylinder as steam, with the exception of that percentage which is liquefied by the performance of work, and that other portion which is condensed by radiation and conduction from the outside of the engine. This means, of course, that steam condensed initially or otherwise, during the steam stroke must be re-evaporated during the exhaust. To use the words of the veteran Isherwood, whose preface to the second volume of 'Experimental Researches in Steam Engineering' is the most masterly treatise on the thermo-dynamics of the real steam engine—not the ideal affair—ever written, we may say that it is the re-evaporation which is the cause of all the waste, because all the water of condensation, which may amount to 30 per cent. or so, has to be evaporated twice, once in the boiler and once in the cylinder, and no mechanical return is obtained for the second evaporation, which is done by the coal on the grate just as much as though it were done in the boiler. Now in the Watt engine no re-evaporation can possibly take place. We have seen that condensation of the working steam is impossible; and any water resulting from the entrance of the boiler steam into the cylinder cannot re-evaporate, because the pressure at which it was condensed remains always the same throughout the whole cycle. The evaporation takes place in an ordinary cylinder only because of the fall of pressure during the exhaust.

"It is not quite clear why Watt did not build engines under his 1769 patent, or,

rather, under the particular portion of it dealing with the engine we have described. Our readers will not, we think, be slow to see that this principle of construction admits of a wider range of application than Watt ever dreamed of; but with this we have nothing to do. Our work begins and ends with directing attention to an old and forgotten invention, whose beauty and excellence should suffice to rescue it from oblivion."

Commercial Review.

NEW YORK, SATURDAY EVENING,
August 26, 1899.

STEAM POWER PLANTS AND OTHER ENGINEERING MATTERS.

The engine market is still emphatically a sellers' market. During the last five or six years buyers have had their innings, and now that sellers have gotten their turn they seem disposed to hold it month in and month out, until they have scored at least one complete calendar year to their credit.

In one of the leading large engine builders' offices it is remarked that buyers fail to appreciate the condition of the market in respect to deliveries. They seem to think that they ought to get their engines right away, and when they find that this is impossible if they are to have a good engine, they turn to a cheaper one.

It is not, however, necessary to wait an unconscionably long time to obtain a small engine of good construction, particularly if you are willing to pay a bonus for early shipment. A certain company which builds engines and other apparatus is now offering its goods at great differences in cost, according to the time of delivery. If you are satisfied to get your engine a month hence there is one price; but if you are willing to pay 25 per cent. or so additional, the company will assemble an engine from their stock of ready-made parts in, say, a week.

Prices of engines, as a pretty general thing, are now nearly one-third higher than they were at the beginning of the year.

A concrete case may help to elucidate conditions in the engine market. J. G. White & Co., engineers, of this city, had occasion to ask for bids on several 1,500 horse-power engines for a mining power distribution plant in the interior of Australia. Figures were requested upon four engines of that size, with an option upon four more. One old-established company wired that they could not take any orders on less than twelve months' time for delivery, and could not take this order on that time. Two other companies, however, could begin to deliver in six or seven months. Probably those terms will be agreed upon if the contract is closed, the engines after the first coming along at intervals of a month.

People are buying iron products in these days very much as they would buy a life-preserver on a sinking vessel. We are told of a case in which a lot of structural material has sold for $120 a ton. Only one man had any that could be furnished as required, so he was able to get a hand-painted price for it. A year or so ago it would have brought only about a quarter of that sum.

A local engineering firm cite an instance of the effect of the iron famine which has come within their purview. Inquiries had been received from Brazil for structural material for a bridge, acqueduct, or something of that sort; but it was found quite out of the question to obtain the material in any reasonable time, and the contemplated buyers withdrew from the market, discouraged and with the intention to build their structure, if possible, of stone or brick.

An agent of foreign parties came to the United States this season with the intention of buying a considerable quantity of engineering material, including a metal structure and machinery. He found prices and market conditions in this country such that he left without awarding the bulk of the contracts, and expecting to place them in Europe.

A prominent engineering firm tells us that, although they have in their offices two or three hundred catalogs of supplies of various kinds, they have not a discount list in the place. This is because quotations are as unstable as quicksilver. Notices of withdrawals are coming in continually. After a flurry of such withdrawals some three months ago a lull ensued, but now the movement has started in afresh. This has especial reference to engineering auxiliaries which can be listed, for instance, steam specialties.

A London dispatch this week stated that the Bristol Tramway Company had ordered of the British Thomson-Houston Company, Ltd., for extension of its line, four 500-kilowatt generators, direct connected to vertical cross-compound engines of the Corliss type; three 30-kilowatt motor generators, two 50-kilowatt lighting machines, 150 car equipments, etc., and that the construction of the electrical apparatus will be done in America by the General Electric Company.

The Harrisburg Foundry and Machine Works have been running day and night, and the company is moving into its new factory about this time. In the local office business is pronounced very active at present. An order has been received for a 700 horse-power four-valve tandem-compound engine for the plant of the Curtis Publishing Company, Philadelphia.

The Hooven, Owens & Rentschler Company has sold, through its Eastern office, two 300 horse-power belted engines for the Bethlehem (Pa.) and Nazareth Passenger Railway Company, two of the same power for the Norfolk & Atlantic Terminal Railway Company, Norfolk, Va. A 700 horse-power cross-compound engine has been ordered by the Warren-Burnham Company, to run a rope drive at a plant in Craigsville, W. Va.

In a fourteen-story office building, the "Broadway Chambers," which is being erected at Broadway and Chambers street, New York, two 100 horse-power Payne engines will be installed.

The Ball & Wood Engine Company is brim full of orders.

During a recent week a supply house of this city is reported to have shipped to Cuba sixteen boilers and eleven medium-sized engines.

The Fitchburg Steam Engine Company is building ten engines, aggregating 3,000 horse-power, for the West Virginia Pulp and Paper Company's new mill at Covington, Va. These engines will all be of the latest type, with standard Fitchburg cam-valve motion, and will be used on severe duty.

The Abendroth & Root Manufacturing Company has been working night and day for the last six months with orders for spiral riveted pipe. Fifteen thousand feet of 12-inch pipe have just been shipped out of the country for water-works purposes. Two 250 horse-power boilers have lately been ordered from Tokio, Japan, and two 200 horse-power will go to Alexandria, Egypt. We understand that shipment of these orders has been made within a few days.

A recent advance in boiler prices is that made by the Stirling Water Tube Boiler Company, of $1 per horse-power. It is stated that the material that goes into boilers such as these has nearly trebled in value in the last year.

The New York Shipbuilding Company, Camden, N. Y., who are entering the market extensively for equipment for their new plant, have drawn up specifications for 1,500 horse-power of boilers.

The conduct of the Indian Government in purchasing railway material from the United States was criticised in the House of Commons last week by a member for Wolverhampton, on the grounds that the haste which made it necessary might generally be avoided by a little foresight, and that low price did not necessarily mean cheapness. He made the assertion that experience had shown English locomotives to last longer than American ones, and therefore to be cheaper.

It is proposed to install electric traction in Lisbon, Portugal. The Companhia Carris de Ferro Lisbon, which has been organized for the purpose with Portuguese and British capital, will have offices, not only in Lisbon and London, but in New York, and an investigation of American electrical systems is contemplated by some of the officials of the company.

The British Westinghouse Electric and Manufacturing Company made an agreement, not very long ago, with the American Westinghouse Electric and Manu-

facturing Company to take over its rights, patents and business for Great Britain and its colonies. A similar agreement has since been made by the former with the Westinghouse Machine Company and the Westinghouse, Church, Kerr Company. The British company will manufacture electrical machinery, steam and gas engines in the Manchester works when these are erected. The Carnegie Steel Company has ordered a 650 horsepower Westinghouse gas engine for its new car axle works. The company has already purchased engines of the same make and size. The Westinghouse, Church, Kerr Company is furnishing five Roney stokers for the United States Government plant at Indian Head. They will install a 10-ton ice-making plant in the Hotel Colonial, Island of Nassau, Bahamas. The hotel is a part of the Florida East Coast hotel system.

A supply house which deals also in a line of bicycle parts is getting an excellent demand for these to go to Europe, particularly Germany, Italy and Sweden. The outlook in this line is rather better than last year. This good foreign demand for bicycle parts is explained on the ground that high duties have injured commerce in the completed wheels and that the tariff on material is relatively small.

It is reported from Glasgow, Scotland, that the tramway committee of that city has accepted the tender of the Edward P. Allis Company for engines to supply electric power, the cost being $572,720. In the local office of the E. P. Allis Company the report could not be confirmed in detail and it was said to be somewhat premature. There seems, however, to be little doubt of its substantial truth.

The recent lease of the Lake Erie Engineering Works, at Erie, Pa., will give to the above company facilities for several hundred men, but to make things easy at least two thousand additional men should be employed.

CHICAGO MACHINERY MARKET.

One of the most significant features of the present market for engines and boilers is the presence of large inquiries from manufacturers who have been contemplating improvements for some time, but during the past few months have been procrastinating, thinking that prices might show a decline. They have come to the conclusion that for the present the market will continue strong, and, moreover, absolute necessity is compelling the purchase of additional power. These remarks apply more to general manufacturing than to the iron and steel industries. In some quarters it is said that the big steel producers are about through with their purchases for the present, but nevertheless quite a number of inquiries from this class of buyers linger in the market. As purchasers of equipment, iron manufacturers have not protested against prices, for their own business has prospered enough to make cost of machinery of small consequence.

Engine builders who construct a medium size are finding an excellent demand from electric companies who are constructing municipal plants at many of the smaller cities and towns throughout the West for lighting purposes. The city fathers are also going into the waterworks development with a great deal of spirit, taking advantage of the more cheerful attitude of the voters in regard to these public improvements. There has been considerable work of this kind going on for some months, but the activity at no time was more marked than now. Electric street railway companies are also very much in evidence, and are among the best buyers of engines and boilers. There is little, if any, diminution in the excessive activity of this market during the past four or five months. The representative of one of the largest builders of boilers in this market says that sales during August are slightly below those for July, June or May, this year, but are largely above those of any preceding August. He is promising deliveries at about the same period ahead as he did a month ago—a good many months—and sees no indication that the late and present demand will decrease. The largest engine builder in the West has enough work engaged to employ his plant for two years. The small engine trade for miscellaneous manufactories notes some improvement this week in the demand, attributed to the budding fall trade. Prices for both engines and boilers are generally higher than a month ago.

The Atlas Engine Works are sold up to about January 1. The foreign business of this company has shown some late improvement, and among recent orders placed were engines for two ice-producing plants in the Philippine Islands.

The higher prices which the electrical people have recently placed upon their product are largely responsible for the leisurely adoption in shops. In dynamo prices there seems to be no uniformity whatever. One large seller here says that within the past month he has advanced prices 30 per cent. Other manufacturers have advanced a more moderate amount. A few of the smaller makers can be found who have apparently not raised prices at all. Certain it seems that the values of electrical equipment have not risen in proportion to the advance in the cost of material. Many delays are occurring by reason of the inability to procure wire and other material entering into the construction of electrical equipment. These delays in some instances are of many weeks' duration.

Quotations.

NEW YORK, Monday, August 28.

Iron—American Pig, tidewater delivery:—

Pennsylvania irons:

No. 1 X foundry	$21 50 @ $23 00
No. 2 X foundry	20 60 @ 22 00
No. 2 plain	20 00 @ 21 00

Alabama irons for delivery in 1900:

No. 1 foundry	20 50 @ 21 00
No. 2 foundry	19 75 @ 20 25
No. 3 foundry	19 00 @ 19 50
No. 1 soft	20 50 @ 21 00
No. 2 soft	19 75 @ 20 25
Foundry forge	18 75 @ 19 25

Bar Iron — Base sizes — Refined, mill price on dock, 2.18 @ 2.25c.; store price, 2.40 @ 2.50c.; common, from store, 2.30 @ 2.35c.

Tool Steel — Base Sizes — Standard quality, 6½ @ 7½c.; extra grades, 12 @ 14c.; special grades, 16c. and upward. Manufacturers have agreed to advance the standard quality ¼c. a pound September 1, and dealers will probably raise their prices sooner or later in conformity.

Machinery Steel—Base sizes—Ordinary brands, from store, in small lots, 2.70c. An advance from this is predicted as a result of what mills have decided to charge.

Cold Rolled Steel Shafting—Base sizes—From store, in small lots, 3¾c.

Copper—Carload lots, Lake Superior ingot, 18½c.; electrolytic, 17⅝ @ 17¾c.; casting copper, 17⅜ @ 17½c.

Pig Lead—Carload lots, 4.60 @ 4.65c., spot, New York, down to 4.55c. for futures.

Pig Tin—In 5 and 10 ton lots, f. o. b., New York, 31¾ @ 32c.

Spelter—Prime Western in carload lots, 5.40 @ 5.55c., with futures even lower.

Antimony—In cask lots and over, Cookson's, 11c.; Hallett's, 9¾ @ 9⅞c .

Lard Oil—Prime, present make, ice pressed, 44 @ 45c., in wholesale lots for the leading city brand, but some prime lard oil may be had for at least 3c. less.

"The young men of the present day," said the elderly person, "have great advantages over the young men of my day, both in education and business training."

"But the trouble is," said the young man, "they have no advantage over one another."—"Indianapolis Journal."

A German inventor has recently procured three United States patents for fortune-telling apparatus. The meaning of the word "useful," as applied to an invention, seems to be a wonder of elasticity. it must be now distended very nearly to the bursting limit.

A company is said to be practically organized which is expected by its promoters to control, "here and abroad," motor vehicles that are driven by kerosene or gasoline. The capital of the company is given as $10,000,000, of which nearly half will be preferred stock.

Some Manchester Tools.

BY JAMES VOSE.

In the article describing Crewe Works, which recently appeared in the "American Machinist," I incidentally mentioned several tools built by Messrs. Beyer, Peacock & Co., Limited, of Manchester, as attracting attention by reason of their general proportions and efficiency. Since that time the firm mentioned have, at my request, kindly furnished, for the information of readers of this journal, photos and some particulars of several machine tools designed and built by them during the last few years. Messrs. Beyer, Peacock & Co. are mostly identified with locomotive work; but it is evident—as noted by Mr. John Richards in his articles on machine tools—that the tools turned out by this firm, as well as tools specially built for them by other firms, have, in addition to the attention paid to the essential mechanism of the machines, had thoughtful consideration bestowed on their general contour and appearance.

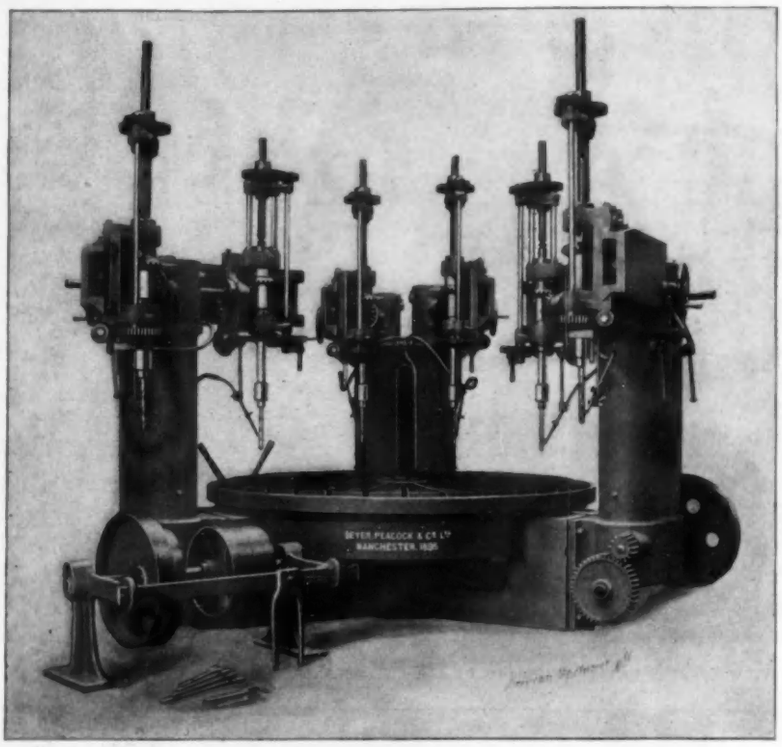


FIG. I. A MULTIPLE SPINDLE RADIAL DRILLER.

During the recent discussions on the orders placed in America for locomotives, it has never been suggested that the quality of work placed on those of British build left anything to be desired, but rather that, on the whole, the work on them was of too thorough a character, and resulted in a machine higher in price and of better quality than is sometimes necessary or desirable. While the lessons of recent developments will not be lost on British builders, it is unlikely they will hasten to lower the quality of their work, but rather seek by improved machinery and organization to cheapen the cost of producing high-class work. Messrs. Beyer, Peacock & Co.'s position as *users* as well as builders of locomotive builders' machine tools has given them special opportunities of noting the requirements of this class of work, and consequently many tools originally designed and built for their own convenience have been quickly appreciated by the engineers of the principal railway companies, other locomotive-building firms and concerns handling work of a heavy character. A steady output of heavy machine tools has gone on from the Gorton Foundry, as Messrs. Beyer, Peacock & Co.'s works are named, for many years, with practically no publicity, as I have never seen them advertise themselves as tool makers, the tools simply selling themselves on their merits, and through the confidence in them with which they have inspired previous purchasers.

A MULTIPLE RADIAL DRILL.

Fig. 1 illustrates a multiple drill designed specially for drilling the rivet holes through the retaining rings and rims of wheels for securing the tires. A tool of this character would appear likely to be very useful in a locomotive shop independently of its special function. The countershaft shows the notched rectangular belt-shipping bar mostly used in English tool practice. The British workman, as a rule, does not take kindly to the friction countershaft generally supplied with American tools.

LINK MOTION GRINDING MACHINE.

Special attention has always been paid at the Gorton Foundry to careful workmanship on link-motion work, and the

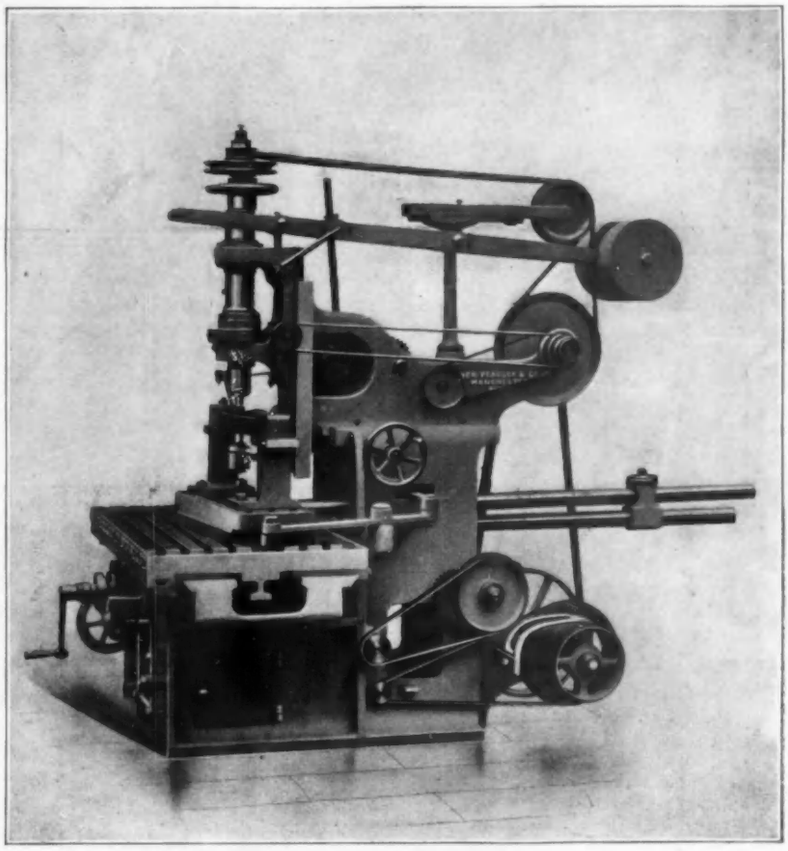


FIG. 2. GRINDING MACHINE, WITH ATTACHMENT FOR LINKS.

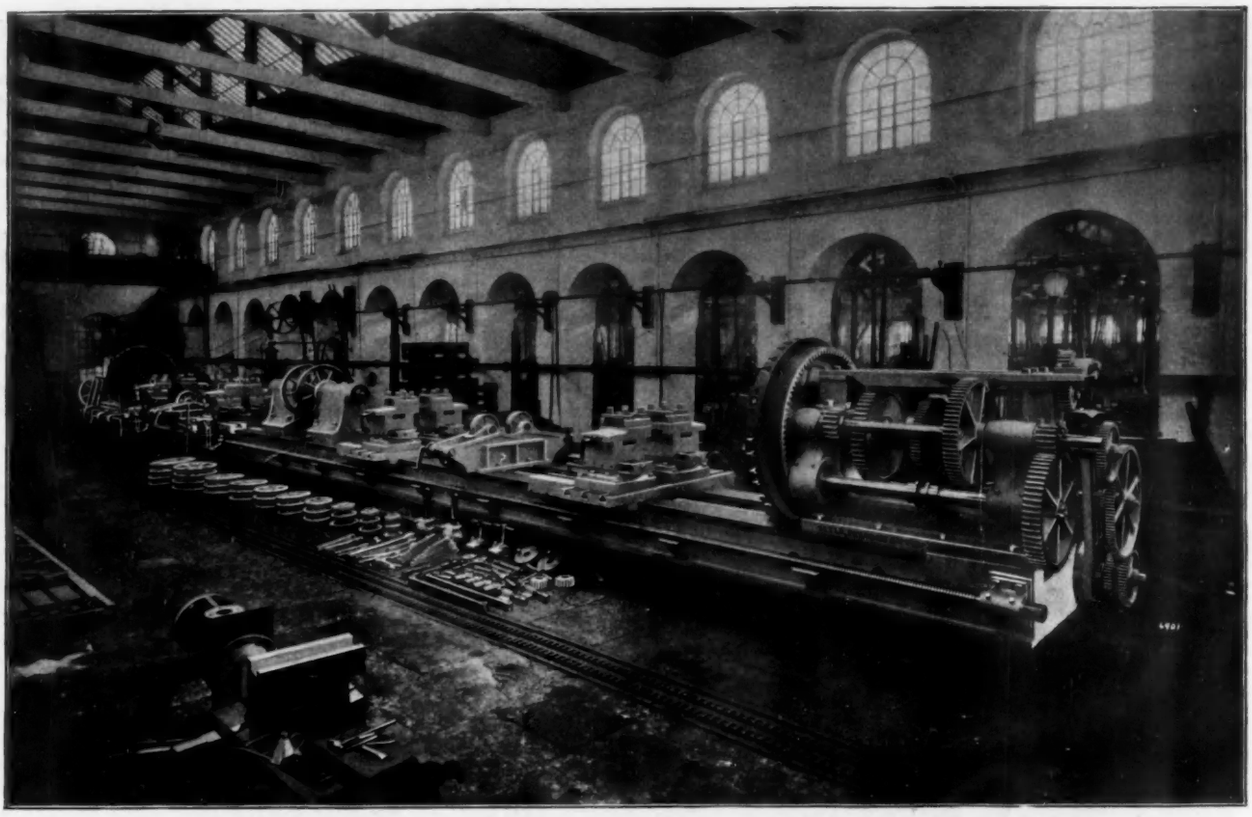


FIG. 3. REAR VIEW OF GUN LATHE IN SHOPS OF ITS BUILDERS.

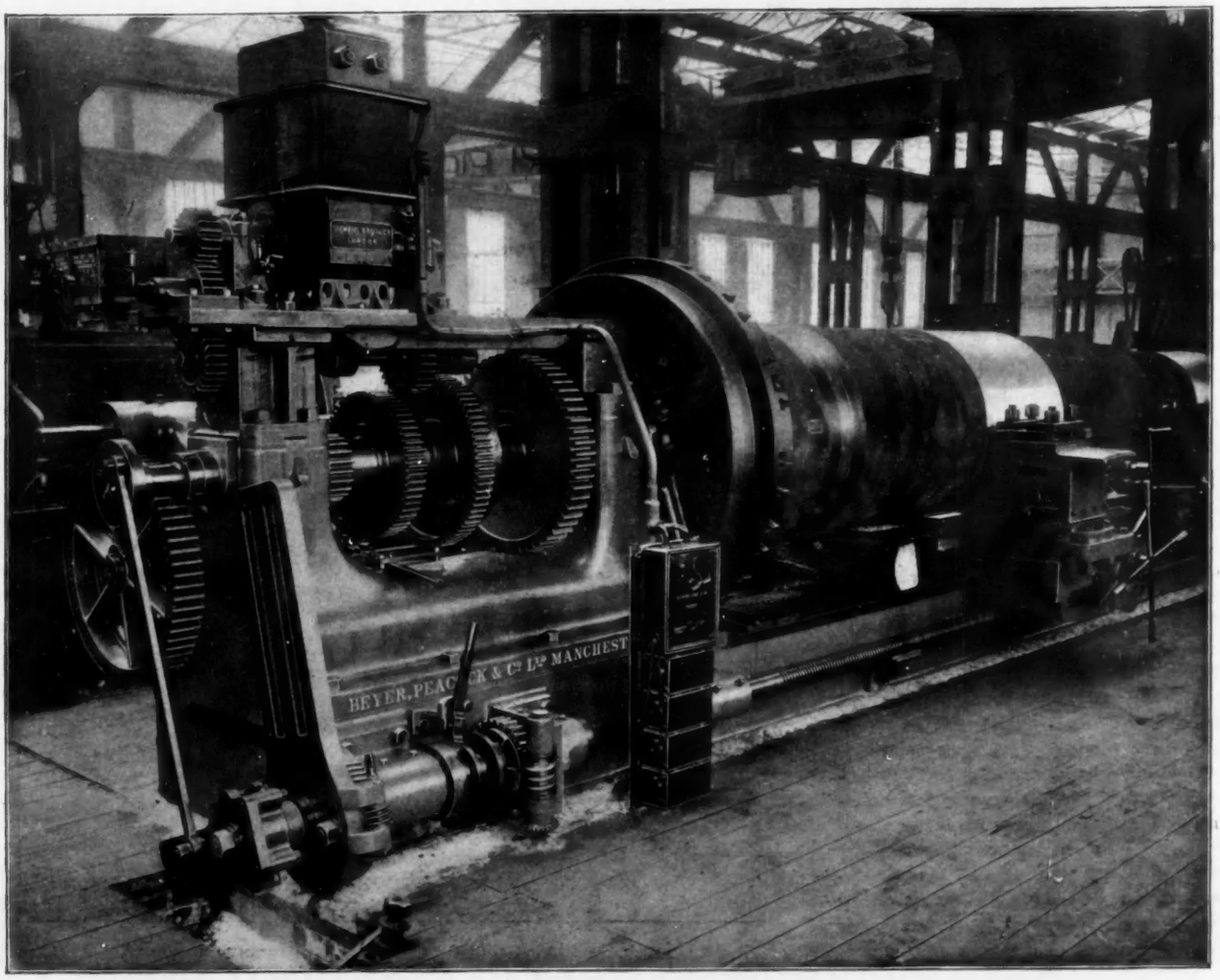


FIG 4. GUN LATHE AT WORK IN SHOPS OF VICKERS, SONS & MAXIM, LTD., SHEFFIELD, ENGLAND.

universal lapping and grinding machine, shown in Fig. 2, has been very instrumental in obtaining good results in that direction. The different motions of the tool are fairly self-evident in the illustration, and the varied uses to which it is applied include truing up all holes in motion work, grinding the working faces of motion links and blocks—both straight and curved—axle boxes, slide bars, etc. I have not seen the machine in use personally, but have heard it favorably commented on by those acquainted with its performance.

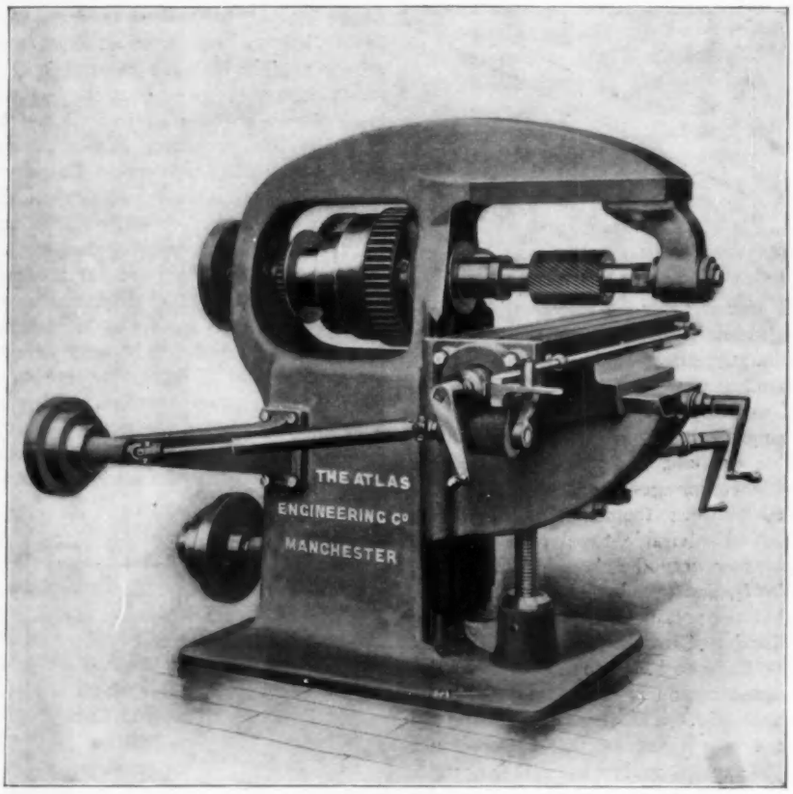


FIG. 5. AN ENGLISH MILLING MACHINE.

A GUN LATHE AND THE POWER REQUIRED TO DRIVE IT.

Messrs. Vickers, Sons & Maxim, Limited, of Sheffield, Barrow, etc., the well-known armament manufacturers, have enormously increased their resources during the last year or two. Among the numerous heavy tools of English and American build recently laid down by them is a lathe of 36-inch centers (72-inch swing), specially designed and built by Messrs. Beyer, Peacock & Co. for gun turning and boring. The lathe is also well adapted for the propeller shafts of large marine engines. Fig. 3 shows the lathe—photographed evidently during construction—and Fig. 4 illustrates the same tool in actual use. I must here acknowledge the courtesy shown by Messrs. Beyer, Peacock & Co. and Messrs. Vickers, Sons & Maxim in this connection, the photo of the tool at work being taken specially for the purposes of this article; and, the lathe being electrically driven, on my suggesting that figures relating to the power absorbed on different jobs would be of interest to the readers of the "American Machinist," Messrs Vickers, Sons & Maxim kindly supplied the desired particulars. As before stated, the lathe swings 72 inches. The bed, which is built up in three sections, is 90 feet long, carrying two head and two tail-stocks, four saddles and eight compound slide rests with self-acting surfacing motion. The guide screw is 90 feet long, and in one piece. The head-stocks were specially designed for electrical driving, and the total weight of the lathe is 221,760 pounds.

The following are the data concerning the power required to drive the lathe:

(a) Lathe running light, with 51,520 pounds gun forging in, slowest lathe gear and fastest motor gear (450 revolutions), 0.6 brake horse-power.

(b) Boring gun carriage (weight 5,600 pounds), cut ⅜ inch by 0.05-inch feed, 1.2 B. H.-P.

(c) Same piece of work, parting cut 2¼ inches wide by 0.04 inch feed, 6.5 B. H.-P.

(d) Rough-turning gun tube, 51,520 pounds weight, four tools roughing, each cut ⅜ inch by ¼ inch feed (two tools on 29 inches diameter and two tools on 19 inches diameter), lathe gear and motor speed as in (a), 10.7 B. H.-P.

AN ENGLISH MILLER.

Mention was made in the article on Crewe Works of three heavy horizontal milling machines in use on link work. On inquiry I find the Atlas Engineering Company call them their No. 12 plain miller. Fig. 5 gives a good idea of the general appearance of the machine, and the following are the principal dimensions: Table, 48 inches long, 12 inches wide; longitudinal traverse, 30 inches; transverse traverse, 12 inches; vertical traverse, 18 inches. The thrust of the elevating screw is taken on ball bearings. The diameter of spindle at front end is 4½ inches, and the total weight of the tool about 6,200 pounds. Both officials and workmen at Crewe seemed well pleased with the capacity of the machines for heavy cutting, and I have since heard the same opinion from other locomotive-building shops.

Manchester, England.

The Construction of Switchboards—II.

BY WM. BAXTER, JR.

In the first article upon this subject the back of a switchboard was shown with the arrangement of the conducting bars and the manner in which they are held in place, by means of their connections with the switches, circuit breakers and other apparatus. It was also shown that there are few cases where it is not possible to support the bars in this way. When, however, the support obtainable in this way is not sufficient to provide the requisite stiffness the bars must be held by attachments that may be made with the marble slabs, but preferably with the iron framing that supports the slabs. Fig. 6 shows a method of supporting the bar from the slab, and Figs. 7 and 8 illustrate a design for holding the bar from the framing, the first figure being an elevation

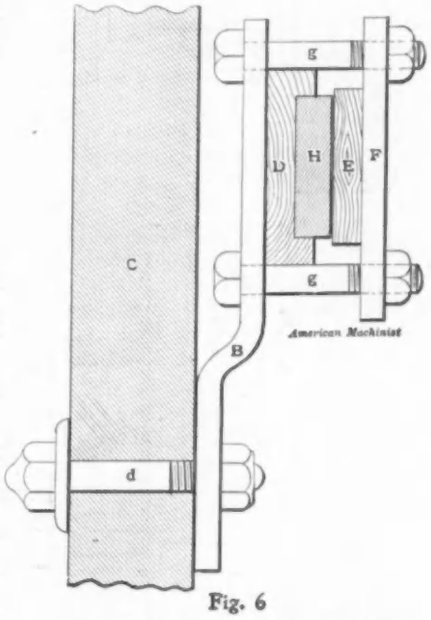


Fig. 6

SUPPORT AND INSULATION OF BARS.

and the second a plan. In all these figures the conducting bar is shown at *H*, and *C* represents the marble slab. Whether *H* is held as in Fig. 6 or as in Figs. 7 and 8 it must be insulated from the clamps *B* and *F*, and from the bolts *g*, so that there may be no electrical connection between *H* and *C* in Fig. 6, or between *H* and *A* in the other figures. Since the object of the insulation is to separate, electrically, *H* from *C* and its supporting frame *A* it follows that if B is insulated from the bolt *d*, and from *C* in Fig. 6, the insulation between H and B need not be provided; that is, insulation at one point between *H* and *d* and *C* is just as good as at another. In the same way, if *B* is insulated from *A* in Fig. 8 the insulation between *H* and *B* will not be required. The construction shown, however, is the simplest and strongest. In Figs. 7 and 8 insulation between *H* and *A* is required because *A* is generally not insulated from

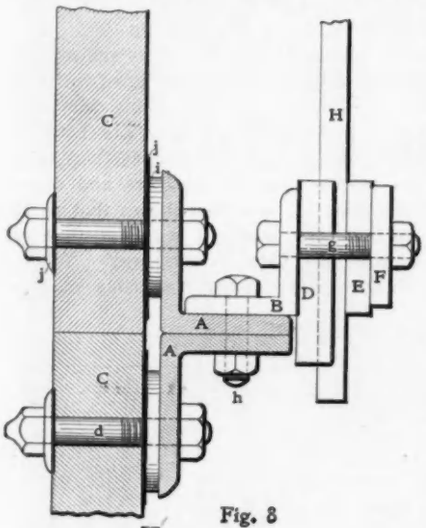


Fig. 8

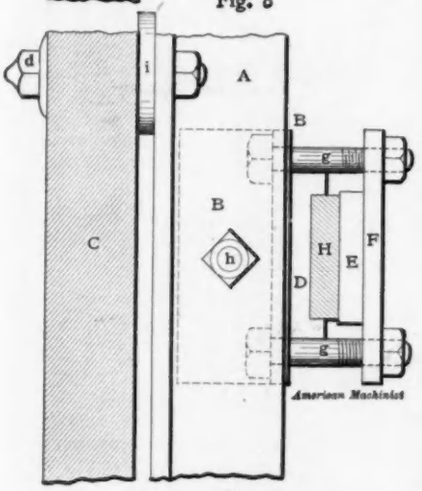


Fig. 7

SUPPORT AND INSULATION OF BARS.

the ground, and even when it is *A* can be grounded accidentally very easily; hence, if there were no insulation between *H* and *A* there would be great liability of grounding the circuit. In a case like Fig. 6, where B is supported from the marble slab, it might be supposed that the insulation of *H* would be unnecessary, and it would be so far as *C* is concerned if the voltage were low, but insulation between *H* and *d* would still be required, for the

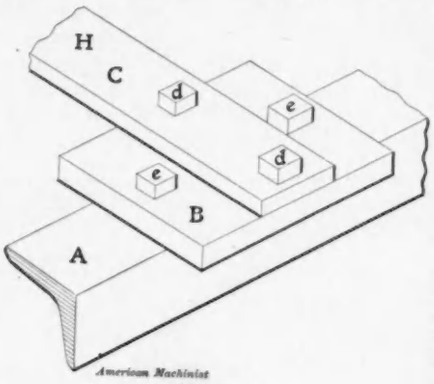


Fig. 9

A POOR METHOD OF SUPPORTING THE BARS.

head of *d* is upon the face of the switchboard, and if not insulated from the circuit damage might be done by accidentally connecting it with some of the switches.

If the voltage is not over 110 the insulating blocks *D* and *E* can be made of marble or slate, and be used alone, but for higher voltages sheet mica should be placed between them and *H*. In every case it is advisable to place a layer of asbestos between the clamps *B F*, and the blocks *D*, and also between these and *H*, so that the pressure of the bolts *g g* may be distributed over a greater surface and not be liable to break the insulators. For the same reason it is well to make the surfaces of *D* and *E* cut away slightly around the edges, so that the pressure may be exerted against the center portion.

In some instances the conducting bars are supported from the framing of the switchboard in the manner shown in Fig. 9, but this construction, as can be readily seen, is not mechanical since *H* is dependent wholly upon the strength of the marble or slate slab *B*. The slab *B* is secured to the framing *A* by the bolts *e*, and *H* is secured to *B* by the bolts *d*. As marble and slate are both brittle, it is not safe to depend upon the slab *B* to hold *H*, for if the pressure of the bolts *e* or *d* should be so applied as to produce a strain the slab might break and allow *H* to fall out of place, and in so doing it might short circuit some of the other conducting bars and result in a serious loss. Since the accidental contact of conducting bars that should be insulated from each other can result in the destruction of the generators, it follows that no construction is proper that is in any way uncertain, and on this account the arrangement of Fig. 9 cannot be looked upon as desirable. It costs less than the design Fig. 8, but in the long run may cost several hundred or possibly thousand times more.

The conductor bars of switchboards are made of copper of the purest kind. Copper castings should never be used unless the pieces are very short, owing to the fact that castings are not made of pure copper, and their resistance is from about one and a half to several times as great as that of the pure metal. The relation between the width and the thickness of the bars has to be determined by the amount of surface required where two bars are joined, and also by the thickness necessary to afford the proper stiffness. A straight bar is made in one piece, but where bends are required they are made by lapping one bar upon another at the proper angle. In some cases it may be found advantageous to heat the bars and bend them into the desired shape, but generally this procedure is not satisfactory, as there is considerable difficulty in handling these crooked pieces when they are entwined with each other on the back of the board. If the points between which the bars are supported are far apart the thickness must be increased to prevent vibration, but bars as thin as ¼ inch may be as long as 4 or 5 feet between supporting points, and if bars that are to be maintained separate from each other are held in position by means of plates of glass or porcelain, where they cross each other, the distance between supports can

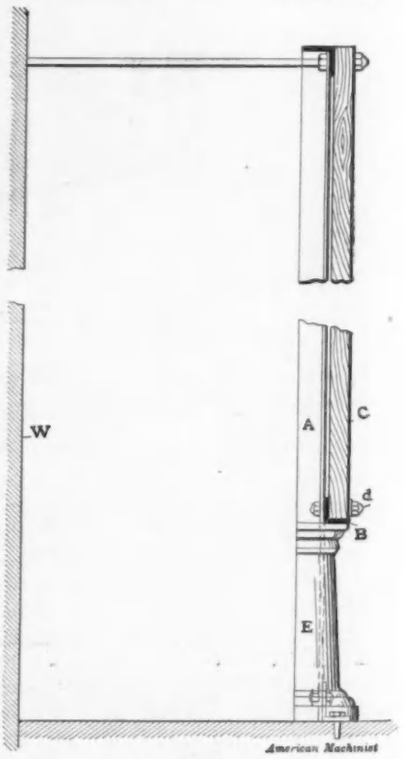


Fig. 10

CONNECTION OF SWITCHBOARD TO ITS FRAME.

be nearly doubled. When glass or porcelain plates are placed between bars the plates should be of a thickness equal to the space between the bars, and the bars and plates should be securely held by suitable clamps.

When one bar is lapped on another

the surfaces in contact should be at the rate of about 1 square inch for each 150 amperes of current for small capacities, and for very strong currents the surface may be reduced to 1 inch per 200 amperes. Two bars 2 inches wide lapped on each other at right angles will have a contact surface of 4 square inches and will conduct about 700 amperes; therefore, the thickness should be about ⅜ inch, which would give a cross section of ¾ inch. The contact surfaces should be as true as they can be made without going to the expense of scraped surfaces, and the bars should be held together with iron bolts or screws, the latter being used for small bars. The number of screws should be not less than two in any case, otherwise the joints may twist around and become loose. It is better to use four small bolts than two large ones, as with the increased number the pressure is more evenly distributed and the contact of the surfaces is made more complete. Iron bolts are better than brass or copper, not only because they are stronger, but also because they do not expand as much as the copper bars with increase in temperature. Therefore, the warmer the joint becomes the more perfect the contact, as the difference in expansion increases the pressure.

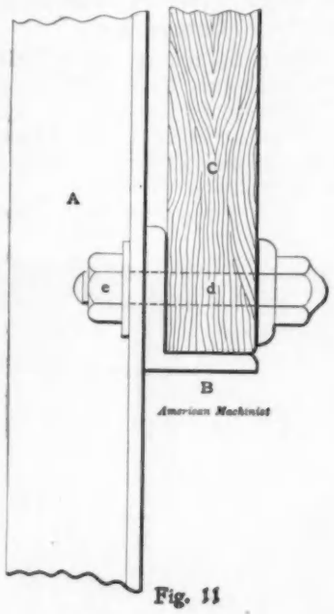


Fig. 11

DETAIL OF FIG. 10.

The supporting frame of a switchboard is a very simple structure, consisting of vertical angle irons placed at the sides of the board, and intermediate angles located where the marble slabs join. These angle iron bars run down to the floor and thus form the legs of the structure. If the board is so small that it can be made of a single slab there will be only two angle bars, one at each side. At the bottom of the board the vertical angle bars are tied together by means of a horizontal bar which is sometimes secured in the way shown in Fig. 10, or more clearly in the enlarged detail, Fig. 11, and sometimes as shown in Fig. 12. If the construction of Fig. 11 is used the angle iron cannot be seen, except by its narrow edge, but with the construction of Fig. 12 the angle can be readily seen from a short distance, as it projects its full width below the marble slab. With the latter construction the marble can be made to rest directly against the vertical angle bars *A*, but with the arrangement of Fig. 11 there will be a clear space equal to the thickness of the side of the angle iron, and unless the bar is rolled with sides of uniform thickness it will be necessary to chamfer away the edges of the slab to obtain a bearing anywhere except at the corner. The top of the switchboard frame is finished off with an angle bar run even with the top of the slab. If the construction of Fig. 11 is used the angle is located as in Fig. 10, that is, with one side between the vertical angle bars and the slab, and the other side resting on top of the verticals. With the construction of Fig. 12 the top angle is placed so as to rest on top of the slab, and the verticals are carried the width of the angle above the slab.

While angle iron is very generally used for the framing of swtichboards, it is not universal. In some instances I-beams are used for the uprights, the arrangement being as shown in Fig. 13, which represents a plan in section through a beam located opposite a joint in the marble. At the side of the board the I-beam is placed flush with the edges. The use of I-beams cannot be said to be as desirable as the angle iron, because it is more expensive and not so substantial, so far as the slabs are concerned, owing to the fact that the bolt holes must be drilled near to the edges, and, therefore, are more liable to break out.

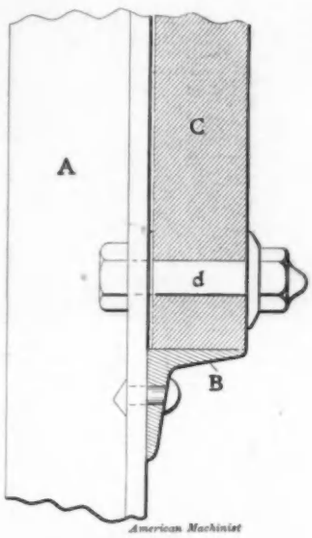


Fig. 12

ALTERNATIVE TO FIG. 11.

The bottom of a switchboard should be of such hight that the attendant can see the lower instruments or switches without inconvenience, and the top should be of such a hight that the highest instruments can be reached from the floor. If space is limited the bottom of the board may not be over a foot and a half from the floor, but two feet should be allowed whenever possible. If the board cannot be made of such width as to permit of placing all the switches that have to be handled within easy reach of a man of average stature, then the board should be made in two stories, with a platform from which the device upon the upper part may be manipulated.

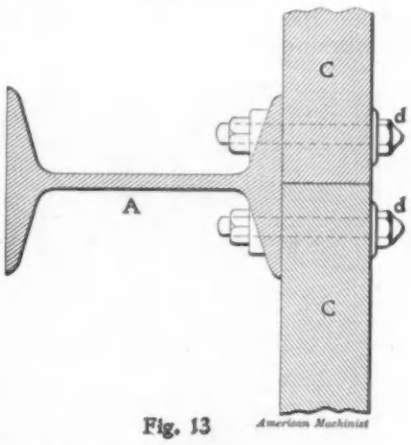


Fig. 13

THE USE OF I BEAMS INSTEAD OF ANGLE IRONS.

The space between the back of the board and the wall should be 4 feet or more, and if possible the location should be such that there is an abundance of daylight back of the board, so that connections may be made when necessary without the aid of artificial light. Artificial lights should also be provided so as to facilitate work after dark. If there are windows back of the board they should be so arranged that rain and snow cannot enter through them and reach the board, and in damp weather they should be closed tightly. A perfectly watertight ceiling should be constructed over the entire switchboard so as to obviate all danger of injury by water falling from overhead.

Switchboard fronts are made of marble and marbleized slate, both of which are suitable for the purpose, when free from seams and metallic veins. Marbleized slate is much superior to the plain stone, as the enamel makes it waterproof. Polished marble is also better than the rough stone, on account of the polish rendering the surface more impervious to moisture. When there is much dampness in the air there is a liability of more or less leakage in the switchboard if the voltage is high. This can be reduced by varnishing the back of the slabs after they have been well dried out by heat.

Martin Fox on Molding Machines.

Martin Fox, president of the Iron Molders' Union, addressed that organization at its twenty-first annual convention, held at Indianapolis last month, and in the course of his remarks spoke as follows regarding molding machines. He said:

"In these closing years of the century one cannot review the long list of evidences of man's inventiveness and skill without a feeling of wonder and admiration. The impossible seems in every field to have been accomplished. The forces of nature have one by one been harnessed for man's use and the gratification of his wants. Handicrafts that once insured the handicraftsman a living have been swept away, and the machine, that neither eats nor sleeps, has taken their places. No handicraft, no trade, is free from danger from this invader. One by one we have seen the domain of the mechanic invaded and his skill rendered valueless. Even those who felt the most secure have fallen the readiest victims. The iron molder for years congratulated himself that little danger was to be feared from the machine in his trade, but, like the many before him, he is slowly awakening to his mistake.

"The advent of the labor-saving machine in the foundry was the signal for an outburst of ridicule and contempt; they were to be laughed out of court; molders refused to have anything to do with them; they were a failure already. But they have outlived that stage of their history, and are to-day a more perplexing problem with which to grapple than ever before. They were relegated at first to the unskilled laborer. To-day that laborer has become a serious rival of the mechanic in many subdivisions of our trade.

"Machines have developed from the simple 'squeezer' to the more pretentious stripping plate and squeezer of later design, and while in some branches of the trade their introduction would not be a paying investment, in others they are a problem which must be met speedily and intelligently. I feel that this convention will agree that this is the case, and that the policy of detraction and opposition must be forever abandoned. It is a truth that all history can be brought to prove, that if a labor-saving machine have merit no opposition that the laborer can bring to bear will prevent its introduction.

"I strongly advise, then, that our members agree to work on those machines and bring out their best possibilities, providing satisfactory arrangements can be made as to wages. The mistake was made at the beginning, when our members refused to work on them; but we should be guided by our experience, and without further delay adopt such a policy as will give to our members the control of the machines and retain to them the trade which they have spent the best years of their lives in acquiring. I strongly recommend, therefore, that the incoming executive officers avail themselves of every opportunity that may present itself to further this policy, and that our members be urged to lend their assistance by sinking all old-time prejudice and making the effort to control the machine that will otherwise control them."

A High Grade Australian Air Compressor.

Through the courtesy of the builders, the Austral Otis Engineering Company, of Melbourne, we are enabled to present herewith illustrations of an air compressor installed by them at the Long Tunnel gold mine of Walhalla, Victoria.

Fig. 1 is a rear view of the machine taken after erection at the mine, and Fig. 2 is a more distant view of the opposite end taken in the shop after erection, but without the flywheel. From these views it will be seen that the compressor is of the duplex type with compound air and steam cylinders. The steam cylinders are also fitted to a condenser and are steam jacketed. Referring to Fig. 1, the low-pressure cylinders are at the left, the intake of air being through the funnel-shaped casting above the cylinder. The inter-cooler is between the cylinders and below the floor.

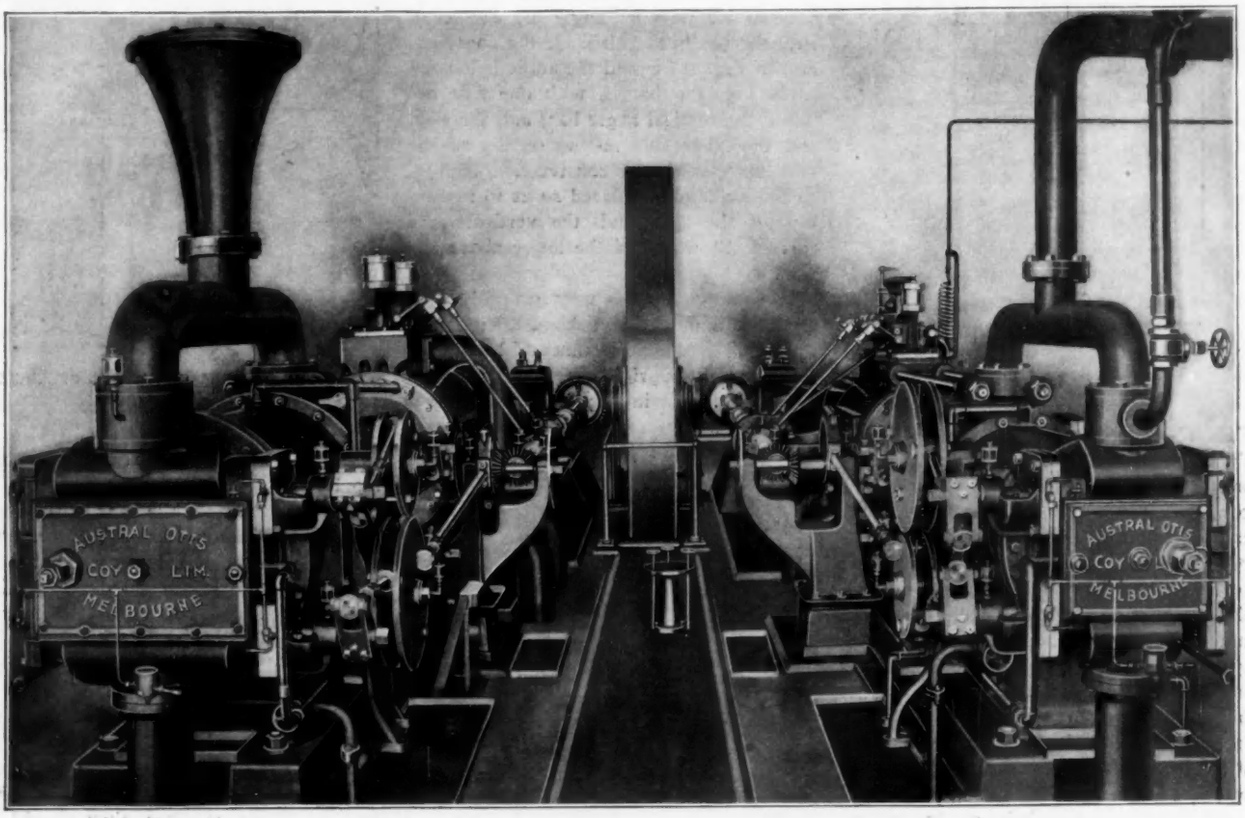


FIG. 1. REAR VIEW OF COMPRESSOR AS ERECTED FOR WORK.

The steam valve gear is of an unfamiliar type to American eyes, though one which is common in Europe. The valves are operated by an automatic trip gear

which is controlled by a pressure regulator and limiting speed governor, the steam valves being of the double-beat poppet type, fitted with air-cushion cylinders to permit rapid but quiet closing. The exhaust valves are of the sliding gridiron type. Both are driven by a shaft running lengthwise of the cylinder and geared to the crank shaft, as most clearly shown in Fig. 2. These same valve gear shafts drive short shafts at right angles to them, placed between the air and steam cylinders, which short shafts, by eccentrics placed on them, drive the wrist plates for operating the air cylinder valves. Separate wrist plates are provided for inlet and discharge valves, the valves themselves being of the Corliss type and positively driven. Positive driving meets all the conditions so far as concerns the inlet valves of both cylinders as well as the discharge valves of the low-pressure cylinder. As regards the discharge valves of the high-pressure cylinder, their proper point of opening varies with the air pressure and with other conditions, and in this country much ingenuity has been expended in devising automatic gears to meet these conditions. In the present machine such devices have been abandoned, the argument being that with the slight change in pressure which accompanies an effective regulator, the gain from a variable automatic opening is too trifling to be worth its cost. Adjustments are, however, provided, whereby the valves may be correctly set in the first instance and altered should occasion demand. It may fairly be asked if the importance of a strictly correct action of the discharge valve has not been over-estimated. The builders of the present machine are, so far as we know, the first who have had the courage to flatly answer this question as they have.

Fig. 3 gives a side elevation of the high pressure cylinder and valve gear, the view extending forward to the small eccentric shaft, and from it the construction will be more clearly understood than from the half-tones. Fig. 4 shows the construction of the discharge valve and the action of the eccentric and wrist plate upon it. Circle *A* represents the crank pin circle, *B* the eccentric circle, *C* the circle in which reciprocates the pin by which the wrist plate is driven, and *D* the circle in which reciprocates the wrist plate pin which drives the valve—all superimposed for clearness. Corresponding positions of the different parts bear the same numbers. Thus with the crank pin on the center at *A*1 (rotation counter clockwise) the eccentric is at *B*1, the pin which drives the wrist plate at *C*1, the wrist plate pin for driving the valve *D*1, and the valve edge at 1, with the port just closed. As the motion proceeds the port is closed by a wide cover, the greatest cover being at 3, followed by a short return movement at 4 due to the action of the wrist plate. Proceeding, the port finally opens with the crank at *A*7 and the eccentric at *B*7. The port attains full opening with the crank at *A*8 and closes again at *A*1.

Fig. 5 is a combined indicator diagram from the steam cylinders and Fig. 6 from the air cylinders, both showing excellent valve and intercooler action.

Following are some particulars regarding the compressor:

Diameter of L. P. air cylinder, 28 inches.

Diameter of H. P. air cylinder, 18 inches.

Stroke, 36 inches.

(Steam cylinders not given.)

Free air capacity per minute, 1,700 cubic feet.

Gross weight, 60 tons.

Cooling surface of intercooler, 158 square feet (that is, 10¾ cubic feet capacity to each square foot of surface).

Volume of intercooler = 1.64 times volume of L. P. cylinder = 3.98 times volume of H. P. cylinder.

Area L. P. air inlet port = 7.2 per cent. of piston area.

Area L. P. outlet port = 4.5 per cent. of piston area.

Area H. P. inlet port = 8.0 per cent. of piston area.

Area H. P. outlet port = 5.4 per cent. of piston area.

The compressor was sold under a guarantee that it would reduce the consumption of fuel to one-half of that required by an existing compressor at the mine, and a five days' test, as well as continued use, show this saving to be effected. Following are some of the results of the test which are extracted from a paper read before the Australasian Institute of Mining Engineers by Mr. E. J. Rigby:

Mean temperature of air in engine room, 70 degrees Fahr.

Mean temperature of air outside engine house, 56 degrees.

Mean temperature of air at low-pressure cylinder delivery pipe, 200 degrees.

Mean temperature of air at intercooler, 110 degrees.

Mean temperature of air at high-pressure cylinder delivery pipe, 250 degrees.

(Temperature due to adiabatic compression, 517 degrees.)

Mean temperature of cooling water to intercooler and jackets, 76 degrees.

Mean temperature of cooling water from intercooler and jackets, 80 degrees.

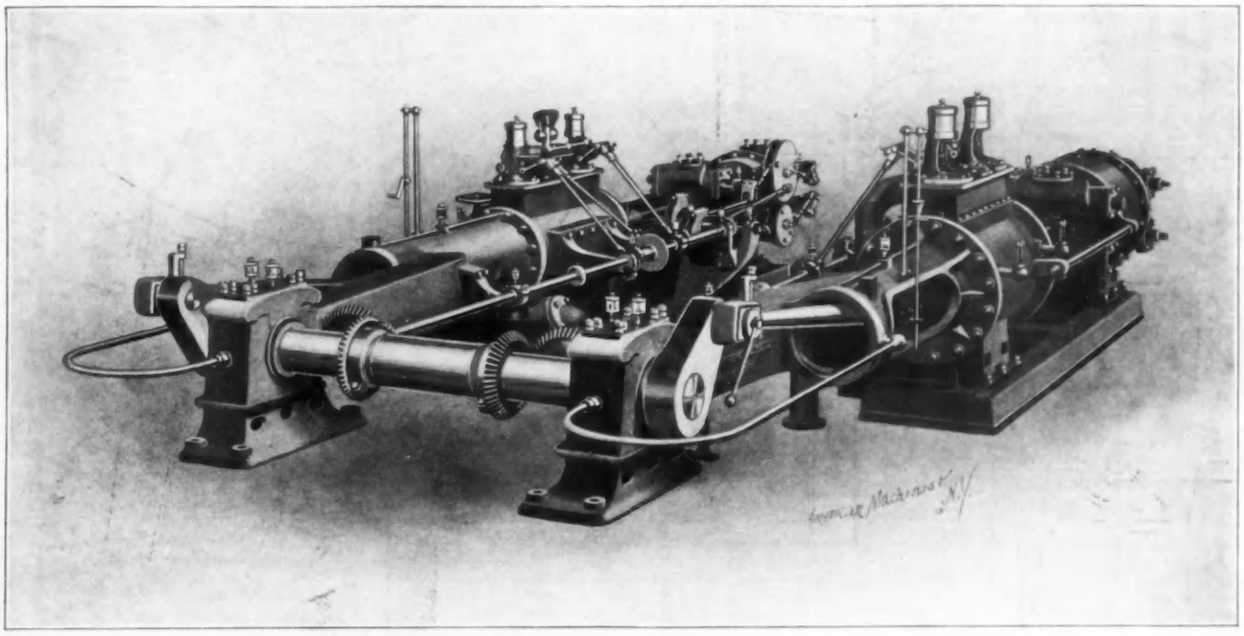


FIG. 2. FRONT VIEW OF COMPRESSOR AS ERECTED IN SHOP.

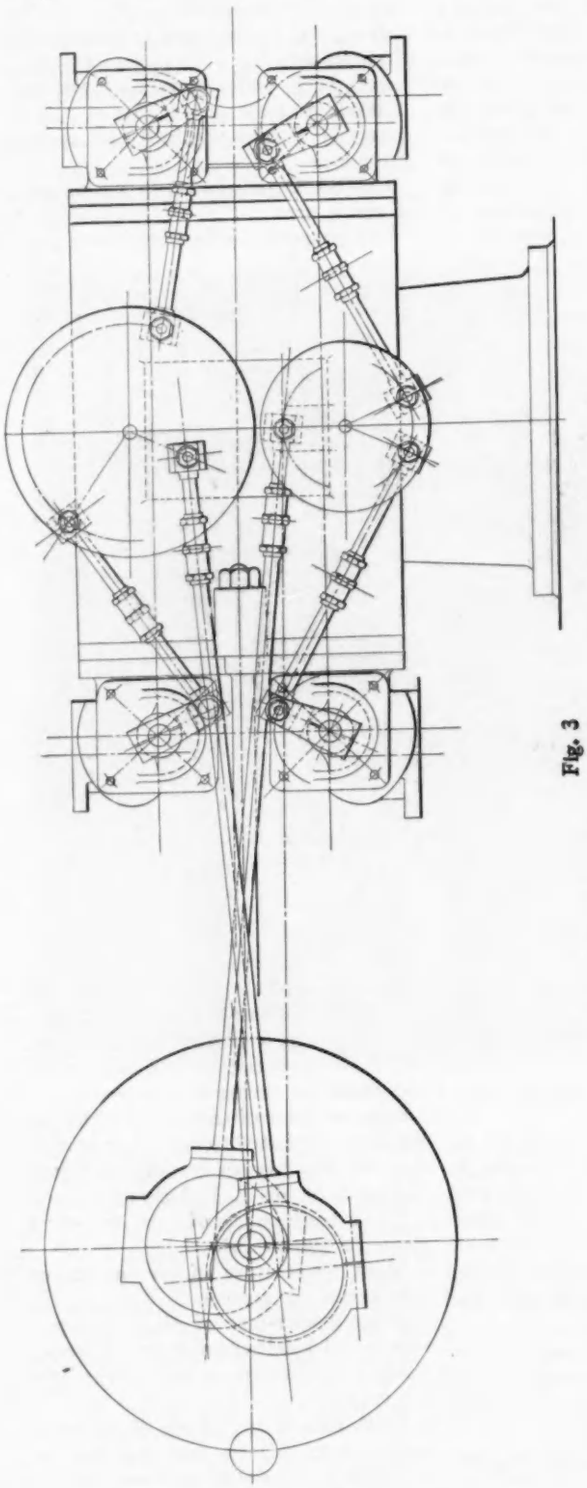


Fig. 3

SIDE ELEVATION OF AIR CYLINDER AND VALVE GEAR.

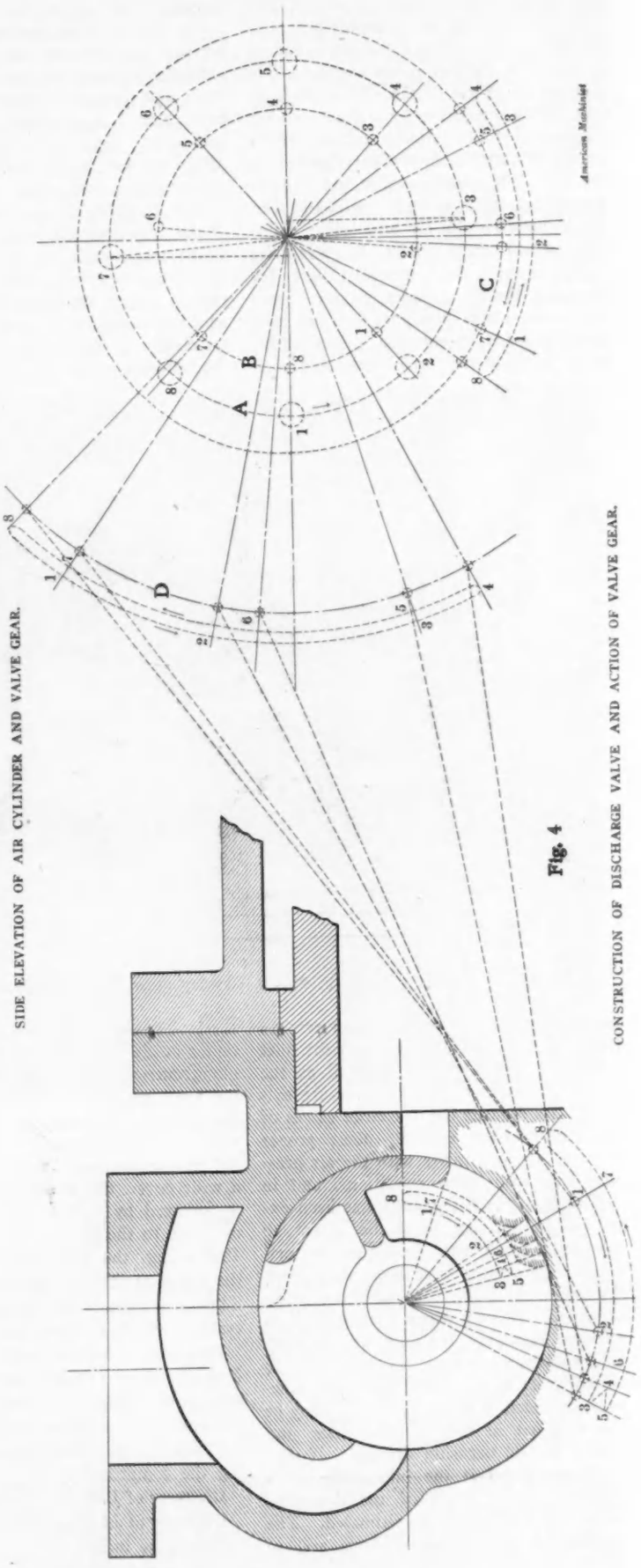


Fig. 4

CONSTRUCTION OF DISCHARGE VALVE AND ACTION OF VALVE GEAR.

Mean steam pressure to high-pressure cylinder, 119 pounds per square inch.

Mean number of revolutions, 30 per minute.

Mean piston speed, 180 feet per minute.

Mean indicated horse-power of engine, 130.

Steam used by compressor per indicated horse-power, 15.4 pounds per hour.

Mean air pressure, low pressure delivery pipe or intercooler, 28 pounds per square inch.

Mean air pressure, high pressure delivery pipe or main receiver, 102.5 pounds per square inch.

Mean indicated horse-power of air cylinders, 123.5.

Mechanical efficiency = air I. H.-P. ÷ steam I. H.-P., 95 per cent.

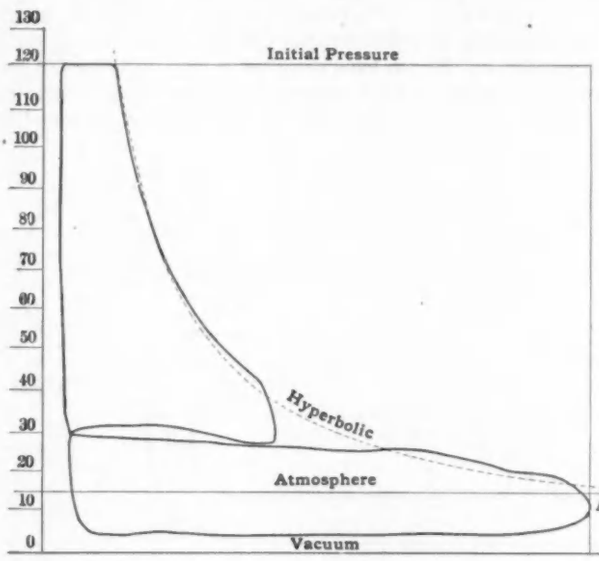


Fig. 5

COMBINED INDICATOR CARDS FROM STEAM CYLINDERS.

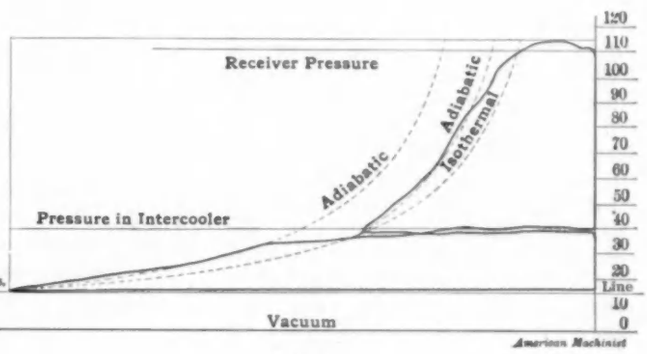


Fig. 6

COMBINED INDICATOR CARDS FROM AIR CYLINDERS.

Mean horse-power calculated from isothermal compression, 103.74.

Mean horse-power calculated from adiabatic compression, 136.4.

Efficiency of compression = isothermal H.-P. ÷ I. H.-P., 84 per cent.

Combined efficiency = efficiency of compression ÷ mechanical efficiency, 79.8 per cent.

In single stage compression the actual M. E. P. does not usually differ much from the theoretical adiabatic M. E. P., and by comparing the actual horse-power with the theoretical adiabatic horse-power the probable gain due to compound compression may be obtained. Dividing thus gives:

$$\frac{123.5}{136.4} = .905$$

or a probable gain of 9½ per cent.

It will be noticed that the combined air cards show an almost perfect action of the intercooler, while the test figures for temperature are not so satisfactory. Regarding this we are informed that the intercooler thermometer was not placed at the intercooler discharge, but was so located as to obtain the mean intercooler temperature, which is to be regretted.

The action of the intercooler as a receiver will be seen to be much better than is common—the fluctuation of pressure in the receiver being very slight. This is due to the large volume of the intercooler as shown in the table of particulars. This large volume is not, we judge, obtained by extravagant size, but by the simple and correct practice of using as the air space of the intercooler that outside of the tubes instead of inside, as often practiced. Not only does this practice increase the air space volume, and so reduce the variation of pressure, but by making the larger outside tube surface the air surface, by leading the air across the tubes instead of along them, and by increasing the time which any given mass of air remains in the intercooler, it doubtless improves to a considerable degree the cooling action of a given lineal length of tubes.

Other features which will be noted are the twin wrist plates and the forked air valve stem levers (also used in the steam valve gear, but not shown in any of the illustrations), whereby overhang of the pins is avoided.

The basis or starting point of the B. & S. or American wire gage has been discovered to be the common wooden lead pencil, whose outside diameter corresponds to No. 1 of the gage with very minute and constant accuracy. No. 1, it will be remembered, is .2893 inch, and the lead pencil will usually be found correct to at least the first two figures.

The Diagnosis of Machinery Troubles.

BY J. M. SWEENEY.

"Look before you leap;" "Be sure you are right, then go ahead;" "It is easy to be mistaken"—numerous adages, sayings, rules of conduct and procedure have been occasioned by reflecting upon some mistake or error arising from failure to reason properly from cause to effect.

Perhaps nowhere is the propensity of human nature to conclude before investigating more often encountered than in the professional work of the mechanical engineer. This is particularly noticeable in attempts to unravel some of the numerous machinery troubles which are constantly demanding to be unraveled. Nothing is easier than to account for a fact with a theory; but it is a different task to account for the fact with other facts which are present. In the field of diagnosis it would seem almost imperative (if one would succeed) to keep clear of the analogy of the cases, and analyze each trouble, which is at all obscure, through its own surroundings. I once listened to a very forceful declamation by an official inspector, upon the subject of a boiler explosion. The evidence in the case was emphatic that a sufficiency of water in the boilers had been indicated immediately preceding the explosion, but the inspector, an ardent low-water explosionist, but not an engineer, unable to stand on any other ground, said: "Why gentlemen, the whole basis of our law [the United States Steamboat Inspection law] is that there must be plenty of water in the boilers, and we know that no explosion is possible so long as there is sufficient water. Now, here the evidence is undoubted that the trial of the gage cocks indicated plenty of water; but, gentlemen, the gage cocks were only in one end of the boilers, and the water must have been out of the other end of the boilers. Yes, gentlemen, because otherwise there could not have been any explosion. Now, what are we to do? Why, clearly, amend the law and require

gage cocks to be placed in both ends of the boilers!"

Erosion, corrosion, pitting, unequal expansion and contraction, over pressure, weak material or bad workmanship had no terrors for this man; all cases determined only by *his* first great cause.

No better advice can be given to any engineer than that which will prevent afore-formed conclusion in cases under investigation. There is an inherent disposition to first establish a theory, then look closely for facts which may support it, but pass over any evidence which conflicts. Avoid such ways; gather all the facts, then arrange them, harmonize them, fit them together. Generally the theory will take care of itself by this time. The resolution of the relation of inanimate things requires patience to work out. A rolling-mill experience of the writer may be interesting.

The demand for steel billets was something abnormal, the company working every possible unit of production to its maximum. Its executive force looked with special interest to the installation of a new reverse mill of large capacity, and the first month's experience with it seemed to put everyone on "Easy street." The mill was driven by a pair of coupled engines, 40 inches cylinder diameter by 60 inches stroke, running up to a piston speed of 650 feet per minute. The external appearance and design of the motive power left nothing to be desired to the critical mind—massive, sweeping lines, powerful, apparently sufficient for every call. The valves were of the gridiron type, and operated through a stationary link, and the reversing action was controlled by an independent steam engine operated from the usual pulpit. The slide-valve seats were situated on the sides of the cylinders, so that the valves stood on edge. Reference to the drawing, Fig. 1, shows a skeleton transverse section through center of the cylinders, and the original arrangement of exhaust piping, which later became an interesting factor in the case.

The slide valve itself is more particularly shown in Fig. 2. As will be seen by an examination of the relation of the valve to the port section, Fig. 3, the particular object of the design was to secure speedy exhaust opening, and this it accomplished very well. The back cover over the valve had its bearing adjusted manually, and this fact later had its influence in the case. In Fig. 3 the back cover and its opening permitting the exhaust over the top of the inner bar will be understood, although not shown.

After about four weeks' operation of this mill with only such troubles as occur with new machinery, and when the management began to have visions of a possible dividend, one morning bright and early, after an eruption in one of the cylinders, the engine came to a halt and refused to move. The investigation which followed developed the fact that the slide valve in one of the cylinders was a complete wreck, being broken into numerous small pieces. A new valve was at once ordered from the builders, and pending its arrival it was decided that the cause of the breakage must have been due to some foreign substance finding its way into the ports, catching and breaking the valve. It was further decided that such action must have taken place through the exhaust pipe, because something (not known what or how) got into the exhaust pipe between the cylinders and was forced back into the broken engine by the exhaust of the opposite one. So in order to remove the cause (?) of the trouble, the arrangement of the exhaust pipe was altered, and a separate pipe provided for each cylinder. After a sufficiency of time the new valve was received, put in position, and operations resumed, which at the expiration of a week were suddenly terminated by the breakage, in a similar way, of the original valve in the second cylinder. Again a new valve was procured, placed in position and work resumed, only to be interrupted after some ten days by the like breakage of the first new valve. At this juncture the superintendent of the works went to the builder of the engines for personal consultation, and it was then decided that the valves were too light in their outer frame, and another new valve was made wherein this part was thickened. This third new valve was finally put in place, but broke in the same way at the end of three days' run.

At this juncture the writer was called into consultation, and the facts before stated were developed. Many of the employees possessed their own particular theory of the cause for the trouble, one being that the grade of valve oil used had been changed. None of these views was permitted to be expressed in the hearing of the writer until after his own conclusion had been definitely reached, after which, and before proceeding upon it, the opinion of the others was requested, without, however, as it happened, throwing any new light upon the subject, or in any way altering the conclusions arrived at.

At the beginning of the investigation it was determined to locate, if possible, the position of initial breakage, and to adopt that as a point of departure. The original broken valve had been scrapped, but the others were obtained. By reason of its greater freshness, the last valve was first examined; that is, the one which had given but three days' service, and the initial break was speedily located at *B*, Fig. 2, the walls of the rupture showing quite a variation from the other breaks in the other valves. It now remained to account for the breakage at this point, and here follows a copy of the written report made on the case, and the recommendation for changed construction:

"Gentlemen—The initial breaks in all of the valves I was able to examine seem to have occurred on the inside bars of the valve, shown at *B*, Fig. 2. The style of valve used is of the 'gridiron' type, and in this case steam is received past the outer end of the valve only, and extends through the openings *S*, Figs. 2 and 3. When the steam enters the cylinder for initial operation it is required to fill the openings *S*, through the valve and against the balance cover which is used on top of the valve. Taking into consideration the high speed at which these engines run, the very considerable strain encountered in reversing them, that the steam connections are excessive, inducing much condensation and considerable water in the cylinders—considering all the facts I have gathered, it is my opinion that the valve breakages have happened in the following way: When steam is admitted into the cylinder, and consequently into the spaces *S* of the valve, it applies a considerable blow to the parts of the valve controlling it. This blow is sustained simultaneously on both sides of the bars *L* (marked in upper right-hand corner, Fig. 2), and they are therefore in equilibrium, while the bar *R* has only one of its sides, the inner one, exposed to this force, its opposite side be-

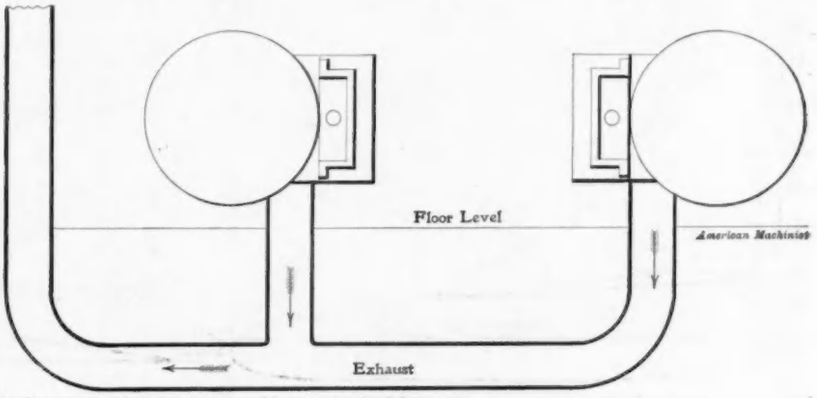


Fig. 1

CROSS SECTION OF CYLINDERS AND VALVES.

ing exposed only to the exhaust pressure passing through the space *N*. This continued hammering finally breaks the bar *R* at *B*, and it is probable that after breakage at *B* it still hung for some time from its other end, finally breaking there, falling into the ports and wrecking the entire valve. Assisting this action was a "form" weakness in the valve, in that it is too light for the duty, and there is an accumulation of strains at point *B*, by reason of unequal shrinkage at the juncture of the light bar and the heavier boss. In the last valve broken this was emphasized by the error in thickening only the outside bars of the valve, thus increasing the shrinkage tension on the valve, and by the fact that core cutting out the pocket *S* had been carelessly set, so that it reduced the designed thickness of the bar some 30 per cent., and that in this diminished section some dirt in the mold had accumulated. I would advise the construction of a

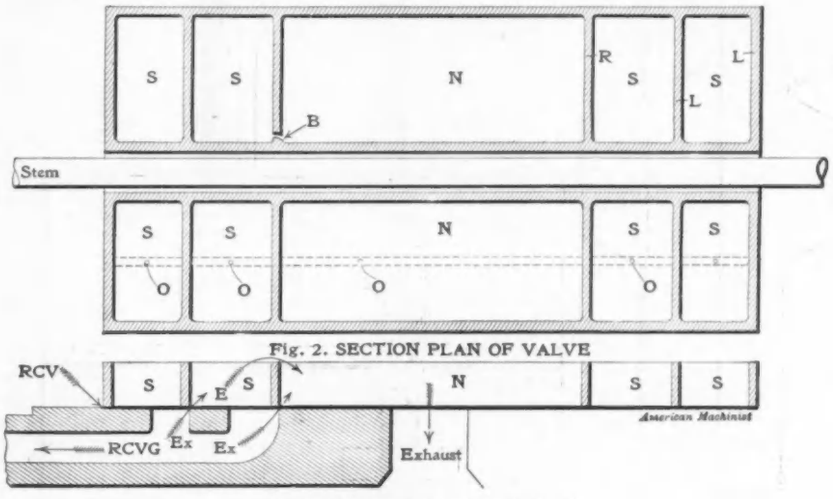


Fig. 2. SECTION PLAN OF VALVE

SECTION OF VALVE AND SEAT

Fig. 3

heavier valve, but particularly the addition of longitudinal bars on both sides of the valve, but shown only in dotted lines on one-half of Fig. 2, and marked *O*."

The diagnosis proved to be entirely correct, the remedy advised was adopted and cured the case.

A Message to Garcia—Management of Workshops

A reader writes us as follows:

"I have just been reading, with interest and pleasure, the article entitled 'The Average Man as an Employee,' in the 'American Machinist.' There are two sides to every argument, and yours is the only answer to the 'Message to Garcia' I have seen, unless it be an answer, which, like the happenings in 'Alice in Wonderland,' appeared in advance of the question—in this particular case, more than a year in advance. I enclose an editorial from the 'Record,' of Philadelphia, of January 26, 1898, which may possibly seem to you of sufficient interest in connection with the message to Garcia and your reply thereto, to reprint in the 'American Machinist' at this time.

"I may say that the incident relating to a steam hammer is literally true, and occurred at the Baldwin Locomotive Works, with S. Vauclain as manager."

The editorial referred to is, in part, as follows:

"It has proven an interesting study to one who has had favorable opportunities during many years of observing closely the daily intercourse between workmen and overseers in several large industrial establishments, to note the value of the personal equation in the management of men—a factor often overlooked in counting cost of product. Diametrically opposite systems are in vogue in different industrial establishments, and each management believes, of course, that its particular method is the best.

"In one establishment, for example, instructions when once given by the manager to an overseer or boss must always be carried out literally; any deviation therefrom is regarded as an unwarrantable infraction of rules. So strictly are these regulations enforced that instances are known to have occurred where an overseer modified his instructions in order to meet certain unlooked-for contingencies which arose during the progress of the work and in the absence of the manager. Although it was evident that the work had been successfully performed at much less cost to the employer by reason of the changes, it was torn out at the order of the manager and reconstructed in strict accordance with his directions; and the overseer was severely reprimanded for having departed from his instructions. The purpose was, doubtless, to teach a lesson of absolute and invariable obedience to orders. This procedure was perfectly proper from the standpoint of the management, and it is not now mentioned for the purpose of criticism, but merely by way of illustration.

"In another establishment of equal or even greater importance the opposite principle prevails. The manager, to whom all matters of importance in the internal affairs of the concern are referred, visits the various departments daily, and gives minute directions and instructions to the overseers, precisely as is the custom in the shops already mentioned. It is, however, well understood by all the subordinates in these works that the directions, no matter how explicit they may have been, are not really cast-iron rules, but are susceptible of modification within reasonable limits. Experience has taught these overseers that whenever such modifications result in better or quicker work, the author of the changed methods, instead of being regarded as a culprit, is rewarded for his ingenuity and skill. A specific instance of this kind which occurred recently may be mentioned in illustration of this method.

"A large steam hammer upon which much work of a hurried kind depended suddenly got out of order, and the fact was at once reported to the manager. He inspected the hammer, then called a certain boss, and said to him: 'You will have to take this hammer off of its foundation and re-set it. Your requisition for helpers will be honored for as many men as you can crowd on to the job; they can be as thick as flies in a molasses barrel, for we must have the hammer at work again as soon as possible.' The manager then passed on to inspect the work of the other numerous departments. The overseer or boss immediately made a thorough inspection of the hammer, thought out a method which obviated the necessity of raising the ponderous machine from its base, and which required only a handful of men to do the work. These few mechanics were at once detailed, and the overseer then went away to look after some other work in another room. Some time later the manager happened unexpectedly again to pass by the hammer; he was amazed to find that apparently little or no work had been done. 'Where's ——?' he called; 'send him here immediately.' When the man appeared the manager, restraining his astonishment and anger, said quietly: 'Tom, when will you have this hammer working again?' 'In about four hours, sir,' said the boss. The hammer was repaired and put to work within that time, which was at least six hours sooner than the manager had thought it possible. The next morning the manager said to this overseer: 'Your work on that hammer deserves more than the thanks of the firm. Your wages will be increased to $—— from this time on.'

"This is a perfectly true and fresh incident which has probably now percolated through all the shops of the great establishment, and which will no doubt stimu-

late other overseers and workmen to exercise their brains in devising better methods of conducting the work under their charge, knowing that both thanks and substantial rewards are awaiting all successful efforts in such directions."

An Automatic Bending Die.

BY H. E. HARRIS.

It is very rare that we come across anything really new; so, although the combination here shown was new to me and to those around me, I do not claim that it will be new to all.

We have here shown a punch and die for bending the blank shown at *A* into the shape shown at *B*, making a "duck's foot," such as is used in spacing the ventilating openings in armatures. In Fig. 1 is shown an end view (partly sectional) of the dies part way on the down stroke of the press, and with the "starters" just about to take hold of the blank. They consist of the tool-steel die *E* and punch *D*, which is screwed and doweled from above (not shown) to the cast iron holder *C*. The die *E* has a groove milled through it lengthwise, with one side perpendicular and the other side at an angle as shown; to this is fitted the wedge *f*, leaving room at the perpendicular side for the blank *x* to be held tightly. Into the wedge *f* are driven the small pins to which the ends of the springs *g' g* are fastened, and then wound in turn around the screws *j j*, and the other ends secured by the small button-head screws as shown. The tendency of these springs should be to lift the wedge up and away from the blank, thus releasing it after bending and permitting a new one to be inserted. The motion of the wedge is limited by the screws *h' h*, which fit loosely in the die *E*, but are screwed home in the wedge.

The blank is slid along between the wedge and the die until it reaches a stop, not shown, which locates it in its proper position; as the press comes down the buffers *e e'* press the wedge down into the die and against the blank, thus securely holding it. The buffers should be long enough to do this before the starters *a a'* take hold, also, the buffer springs *i i'* should be quite stiff. Referring to Fig. 1: The starter *a* is pivoted on the pin *b*, which is on the opposite side of the center line from which the bend is to be made.

The little arm at the upper end serves as a stop to bring the notch, shown at *l*, directly over the edge of the blank, and the projection at the lower end has a cam on its upper side upon which the plunger *c* works, actuated by the slight spring *d*, thus returning and retaining the starter in position shown after each stroke of the press. The top edge of the blank, catching in the notch of the starter during the down stroke, is carried over by it in the direction of the dotted line *K*, until it reaches the face of the punch *D*, which it then follows till the final bump flattens it out at right angles with the part held in the die E. As the two "feet" of the blank are to be bent in opposite directions, the two starters, *a* and *a'*, must work in opposite directions, the pins *b' b* and the plungers *c' c* must be on opposite sides of the center line. All parts of this punch are hardened, and the starters have to work very freely on the pins *b' b* and in the slots of the punch *D*, so that there will be no binding when under pressure. I made this die to bend the above blank in one operation, which before had always been handled twice in two sets of dies. It was very successful, bending thousands to my knowledge, and I believe it still to be in active operation.

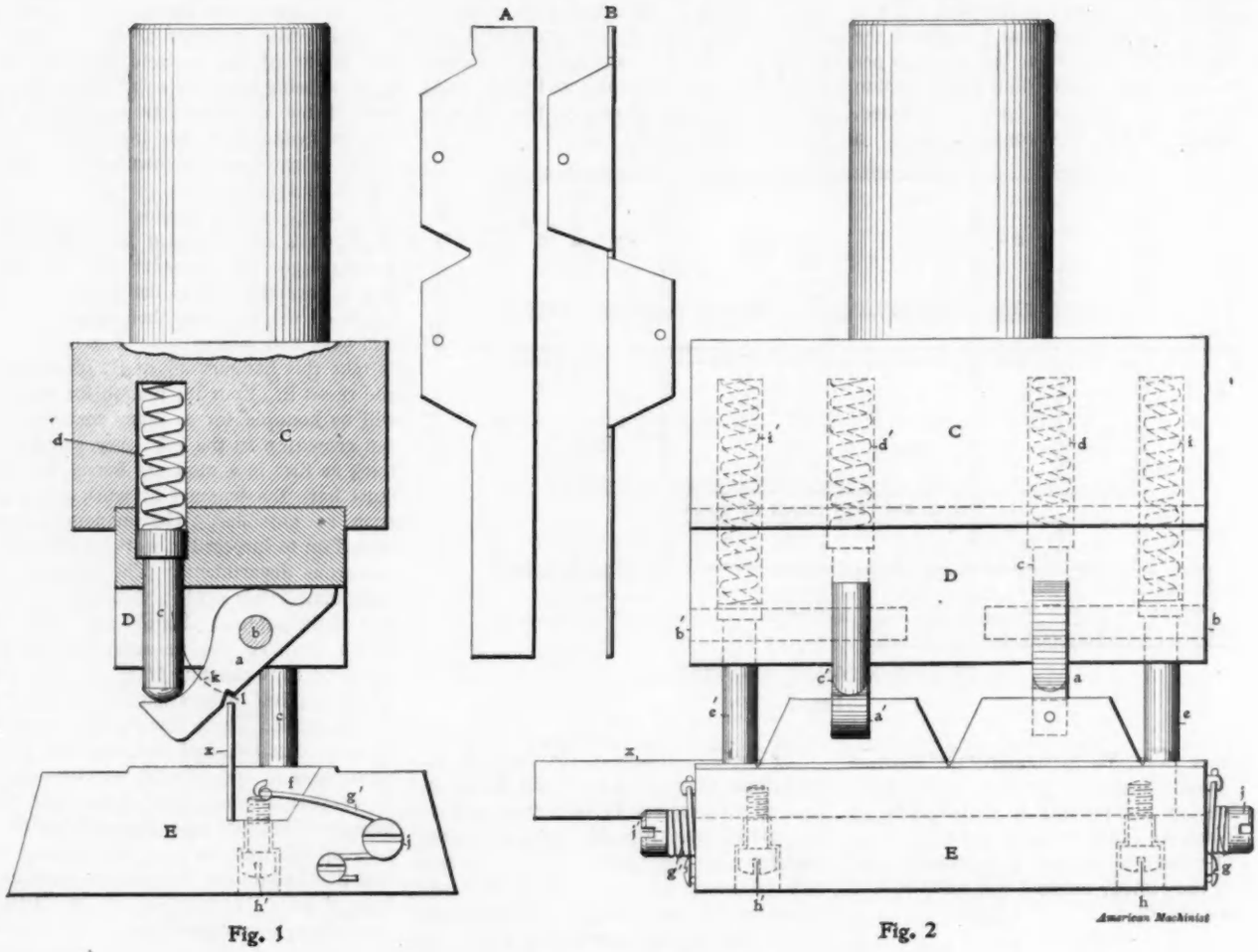


Fig. 1 Fig. 2

AN AUTOMATIC BENDING DIE.

Letters from Practical Men

A Chuck for Facing-off Work of Uniform Thickness.

Editor American Machinist:

Some time ago I had occasion to make the following chuck, which I think is a very good one, and will prove so to to anyone wishing to try it. The chuck was in this case fitted to a No. 5 bench lathe, but it can be made to suit any lathe of the draw-in collet type. The face plate *A*, Fig. 1, is fitted to the spindle of the lathe and is recessed to receive the split collet *B*, Fig. 2, deep enough to allow perfect freedom for the collet to grip the work in case of any variation in the size of the blanks to be faced. The collet is milled through its largest part, four or five one-hundredths wider than the bridge *C*, Fig. 3, to give clearance, the balance of *B* being sawed with a small saw, as shown, to allow the necessary spring. The bridge *C* is fastened to the plate *A* by the screws *D*, Fig. 6, and is hardened and then ground on its face when in position on the spindle. Figs. 4 and 5 are steel plates worked out to fit the work desired to be faced and screwed to the collet, which is cut after the plates are in place. In this case the parts to be chucked are armatures for relays, which are required to be of a uniform thickness. The collet is spring-tempered and ground to fit the angle of the face plate, which is 20 degrees. No matter what the variation in diameter of the work is, so long as it is within a reasonable amount, say one hundredth of an inch, it never can be drown back with the collet to change its thickness, as the work, when put into the chuck, rests on the bridge, and the collet is then drawn in until it grips it. The complete section—

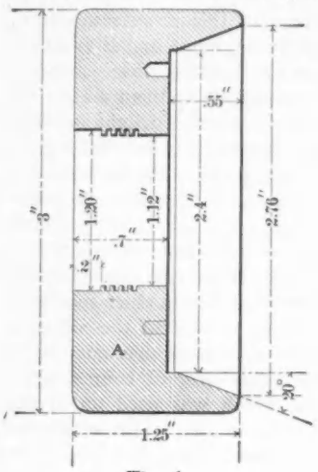


Fig. 1

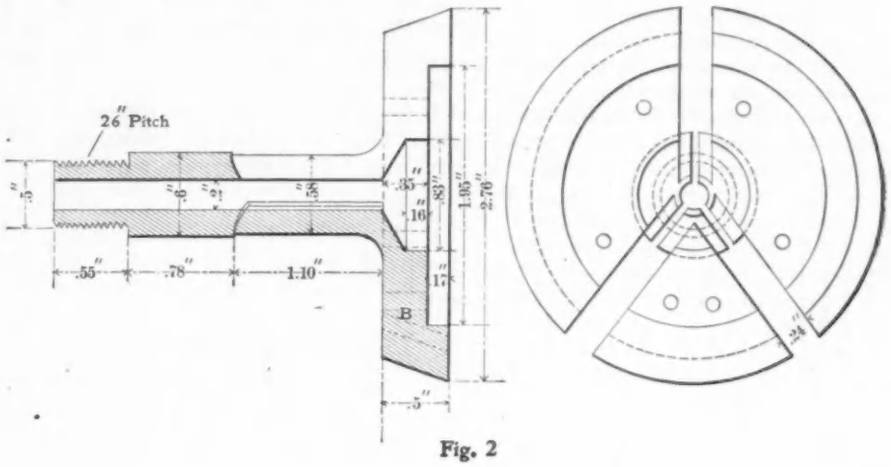


Fig. 2

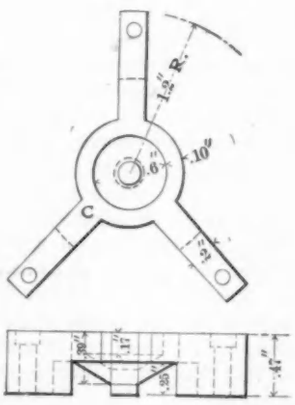


Fig. 3

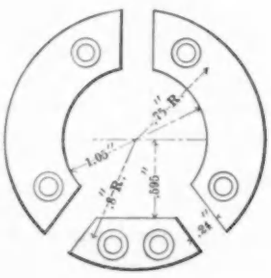


Fig. 4

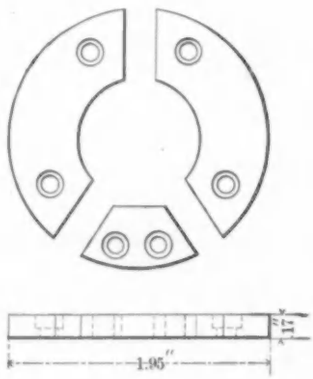


Fig. 5

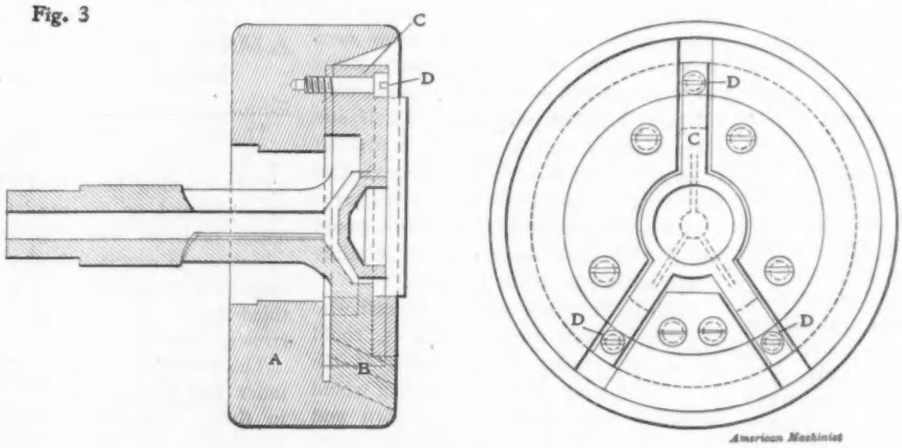


Fig. 6

A COLLET CHUCK FOR WORK OF UNIFORM THICKNESS.

Fig. 6—will show the arrangement clearly, I think, and for many jobs where accuracy in thickness and speed are required it will be found to be a very good chuck.

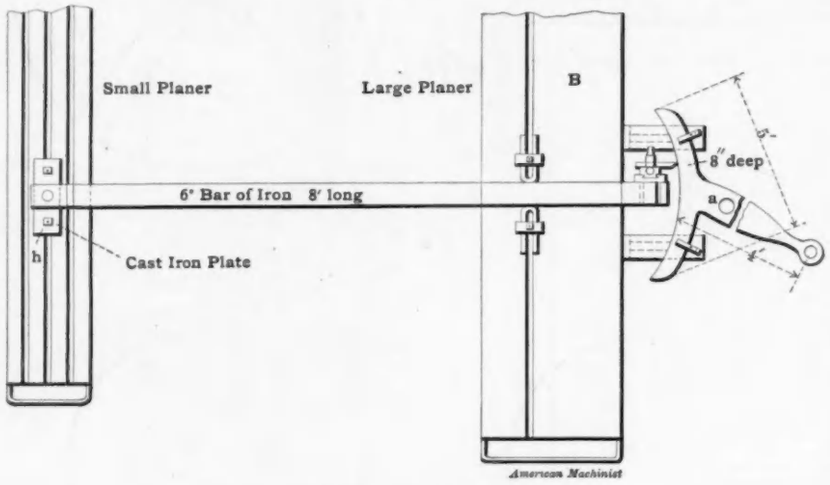
M. W. LEECH.

A Circular Planing Job.

Editor American Machinist:

We once had a very crooked job to do at a shop where I was employed, and we had no tools large enough to do it. The work consisted of thirty wrought iron arms that weighed about 800 pounds each (shown at *A*), with a concave circular face to be planed. After looking about we found the means of doing the job in a small and large planer, standing side by side, with a distance from center to center that would answer all purposes.

First we hunted up a bar of iron about 6 inches square and 8 feet long. Through one end of this we drilled a hole about 2 inches, fitted a pin to it, cut a thread on one end of the pin and screwed it fast to a cast-iron plate that we clamped to the platen of the small planer. We then clamped this platen fast to the bed of the planer so that it could not move while doing the job. On the table of our large planer we bolted two clamps so that the ends would be just far enough apart to admit the 6-inch bar between them and shove it either way. On the end of the bar we clamped the tool rest of a 26-inch lathe. The slide of this rest was vertical and operated by hand. To hold the arms for planing we bolted two angle plates to the side of the planer bed, with the top just high enough to bring the arms an inch or so above the planer table. After selecting a tool for the work and adjusting the stroke of the table *B* to suit the length of the arm we were all ready. The total cost of this rig was so low that when it was divided into the number of pieces finished there was nothing to speak of in comparison with the interest on a large mill for boring. The sketch will show the method adopted, and the work was finished in a very satisfactory manner.



A CIRCULAR PLANING JOB.

Now while we might say, "that is all right for a jobbing shop," we must not forget that in this day of improvement there are changes looming up in every shop that require special rigs for doing work and which could not wait for permanent tools. In these letters of mine we shall have occasion to mention a goodly number of them. It does not pay to sit down and wait for some tool to be made to finish a job that is in a hurry.

H. S. BROWN.

Easton, Pa.

That English Clothes-Pin.

Editor American Machinist:

That clothes-pin described in your issue of August 10 is, I am sure, not altogether "English, you know." About two years ago a band of gypsies were encamped on our borders, and a young lad from the camp was selling just the same thing, and my wife bought a dozen. They were made of soft, white willow, and with the bright tin and tack presented a nice appearance. I thought when I read the article I could readily send you another, but my wife says they soon went to pieces. The boy sold them for 3 cents per dozen, which was cheap enough, considering the work on them. But if one were a gypsy and had "dead loads" of time, and loved to whittle and could steal his living and materials, all but the tacks (the tin scraps any country tinner would be glad to give away), there certainly would be money in the business.

Perhaps Elizabeth Robbins Pennell, who is such an authority on gypsies, could throw some light on the subject of the origin of the pin. But the question would naturally arise, would a free-born and nomadic gypsy every need such an article for his own use? The line on which to hang the clothes would antedate the pin, and the pin would be the next step towards a better order of things.

I was interested in the article, for when I was less than ten years old, my father made a foot lathe on which I did lots of kicking, and I made clothes-pins and sold them for a shilling a dozen.

Tunkhannock, Pa. F. P. AVERY.

Editor American Machinist:

I notice that a correspondent thinks he has found a novelty in the shape of an English clothes-pin. Why did he not give it its proper English name, and call it a clothes *peg*?

The antiquity of this manufactured article is probably unknown, but it is an instance in which the fittest has survived. I have seen thousands of them made; for forty years ago I used to delight in visiting the gypsy camp in some shady lane, near to woodland, where the material for these pegs was easily obtained, and without price.

These gypsies were also manufacturers of pots and pans (tinware), and before the days of railways, were the chief source of supply for these articles to the villagers of rural England. In the manufacture of this tinware, there was, of course, a lot of scrap tin, which was used up in the production of these pins. This scrap was cut into convenient pieces, each piece with a pointed end. This pointed end was inserted into a piece of green wood, about 4½ inches long and ¾ inch diameter, more or less, from which the bark had been removed, and the strip of tin wound tightly and spirally round and secured by a tack at the other end. They are then split and what your correspondent calls the "fish mouth" is formed.

The rapidity with which these gypsies can make them is remarkable, and they are cheaper and better than the American-made article, which is now to be had anywhere in England. I say "better," because they rarely split, which is the common failing of the sawn pin in use here. The fact that they retain their popularity is proof of this. JOHN E. MELLOR.

A Milling Machine Attachment for Indexing Minutes of Arc.

Editor American Machinist:

The following is a description of a simple attachment for the B. & S. universal milling machine head which may be used in compound or differential indexing to obtain divisions where the angle reads in minutes. In simple indexing it is possible only to obtain one-half degree and one-third degree by using the 18 and 27-hole circles, respectively.

The attachment, Fig. 1, fits the 18-hole index and divides any one of the spaces in three equal parts, thereby becoming practically a 54 index. It may be made from a strip of steel ¼ inch wide and ⅛ inch thick, the outer holes transferred

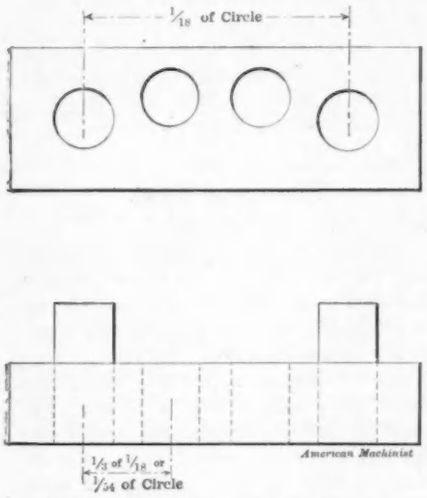
from the 18 circle, and plugs put in to locate it on index. By mounting the index centrally on chuck, and indexing with the 27 index 20-27 of a turn the remaining holes may be drilled in accurately on the same circle.

In considering the differential indexing, the rules and method of determining them will be given first for divisions wherein the minutes are exactly divisible by 3, the attachment not being used.

One turn of an index moves spindle 9°, and one hole of the 18 circle gives 30′, also one hole of the 20 circle gives 27′. Therefore in moving the 18 forward and the 20 backward a forward movement of 3′ results; two holes of the 18 forward and 2 of the 20 back give 6′; 3 holes of the 18 less 3 of the 20 = 9′, etc. And it is clear that the total number of minutes in any division divided by 3 shows the number of holes to move the 18 and 20 circles in opposite directions.

Nine holes of the 18 circle are equal to 10 holes of the 20, for each moves the spindle 270′, each is a half a circle movement of the index pin.

Let A denote the 18-hole circle and B



INDEXING ATTACHMENT ENLARGED.

the 20 circle. We have $9A - 10B = 0$; or 9 holes forward in A less 10 holes in B does not move the spindle. In divisions where the differential movement is greater than 10 holes each, 9 holes of A and 10 of B may be stricken out. Thus a division of 33 would be $11A - 11B$, when by taking away 9 from A and 10 from B there will be left $2A - 1B$. Two holes of A = 60′ less 1 of B = 27′ = 33′. Again, in 69′ the indexing is $23A - 23B$. Now by dropping $9A$ and $10B$ twice, or $18A - 20B$, there remains $5A - 3B$. $5A$ = 150; $3B$ = 81; 150 − 81 = 69.

In wide divisions, for example, 16° and 24′ or 984′, the indexing is 984 ÷ 3 = 328; i. e., $328A - 328B = 984'$. $9A - 10B$ may be taken from this a number of times—in fact, as many times as 10 is contained in 328, which is 32 times. 32 × 10 = 320, and 32 × 9 = 288, which is 32 less than 320. Expressed algebraically, we have $328A - 328B - 288A - 320B = 40A - 8B$, which is the indexing required.

In this example, as in all others, the number 328 ÷ 10 is equivalent to pointing off the right-hand figure. Thus, 32.8; the 32 shows how many times 10 is taken from the number, and the remainder, 8, is the backward movement of B. Nine must also be taken from it 32 times, which leaves a remainder 32 more than 8, or 40. for A. For every 10 holes taken from B one less hole must be taken from A, and in 32 × 10 holes from B 32 less must be taken from A. Hence the remainder for A will be 32 more than B. This gives a simple rule for 3′ divisions, as follows:

Rule—Divide the total number of minutes required by 3; point off the right-hand figure of the quotient, separating it into two numbers. The sum of these two numbers is the forward movement of A, and the right-hand figure the backward movement of B.

Example—Find indexing for 16° 15′. 16° 15′ = 975′. 975 ÷ 3 = 325. 32.5. $32 + 5 = 37$. $37A - 5B = 975'$.

For one-minute divisions the attachment is used, and if the above rule were applied it would give a fractional division for the 20 circle. As this circle cannot be subdivided to give result, it is necessary to get the fractional division on the 18 circle, where the attachment is used. The following example will illustrate the method and explain the rule. Point off the minutes *before* dividing by 3, then add or subtract $9A - 10B$, as may be necessary to make coefficient of B divisible by 3. Divide result by 3, and the quotient is indexing required.

Example—Required indexing for 10° 14′. 10° 14′ = 614′. Pointing off, we have 61.4. $61 + 4 = 65$, $= 65A - 4B$. Subtract algebraically $9A - 10B$, and the result is $56A + 6B$. Both signs are positive, indicating that both movements are forward, or in same direction. Now divide by 3, which gives $18\frac{2}{3}A + 2B = 614'$, the required differential indexing for 10° 14′. To prove this: $18\frac{2}{3}A = 560$. $2B = 54$. 560 + 54 = 614′.

Example—10° 16′ = 616′. 61.6 = $67A - 6B$. $67A - 6B \div 3 = 22\frac{1}{3}A - 2B$. Here it is unnecessary to add or subtract $9A - 10B$, as the $6B$ is divisible by 3.

The algebraic terms may be eliminated, and the rule stated as follows: Find total minutes and point off right-hand figure, separating it into two numbers. The right-hand number is reading for B backward, and the sum of the numbers reading for A. If B is not divisible by 3, add it to or subtract from 10, so that it will be. If it is subtracted, then take 9 from A and divide by 3, both movements being forward. If added to 10, then add 9 to A, divide by 3, and B is backward.

S. O. Bartlett.

Hartford, Conn.

Electrically Operated Valve Gear—Is it a Simplification or a Complication?

Editor American Machinist:

I suppose that the announcement made by Mr. Tecumseh Swift, in your issue of July 6, that some mechanics are now endeavoring to replace the apparently complicated Corliss valve gear by an apparently simple combination of electrically operated or controlled valves, was sooner or later inevitable. The problem is attractive, and the field for seeming improvement is enormous, and the only matter which should cause astonishment is that we have not before heard of several large syndicates formed for the purpose of exploiting some schemes of this kind. Had any such corporation appeared, I do not think that there would be any lack of investors. The men who look at an electric car "and often may be heard to explain how very soon there will be no steam engines" would jump at such a chance, even though it might appear to them that a means of dispensing with eccentrics, wrist-plates, valve rods and dashpots, was but the first step towards the attainment of their millennium. In short, the financial man who lays his money on a scheme for electrically controlled valves ought to have nothing much to complain of. For the benefit, however, of the investor who may be tempted to spend money, or of the inventor who bestows his skill on the problem, it may be worth while to spend a few moments in looking a little closer into this question.

Broadly speaking, such schemes fall under two heads: (1) Those in which valves are operated and controlled solely by electro-magnetic means; (2) those in which valves are operated by a steam relay controlled electro-magnetically. Other schemes are possible, but unlikely. In special cases, for instance, a pneumatic relay electrically controlled might be used. As, however, it would only be of service in exceptional cases, and as it offers, beyond a few convenient qualities, no essential advantage over a steam relay, it is not worth discussion.

Valve gear, however operated, has, in all except a few isolated cases, to perform certain operations, which may be roughly classified under one of the following heads: (a) Reciprocation of one, two or four valves of the gridiron or slide type; (b) Alternate partial rotation of cylindric valves of the Corliss or Wheelcock type; (c) Reciprocation of four balanced drops or double-beat valves of the Sulzer type.

Combinations of these methods are sometimes adopted. It is evident, without explanation, that all these operations can be performed by mechanism falling under one or other of the heads 1 and 2. It is needless to point out that the size of the valve itself is not affected by any pro-

posed change in the method of operating it. The friction of the valve will therefore remain at its present value, and the only hope of gain in mechanical efficiency lies in the difference between the power expended in moving the external valve mechanism under load and that needed to effect the various transmissions from mechanical to electrical energy, and *vice versa,* in an electrically operated valve gear. What this ideal saving would be it is impossible to say, but the percentage of power of any good Corliss engine which is used in overcoming the friction of eccentrics, rocking arms, wrist-plates and valve rods must be so small as to make it very doubtful if a small percentage saved on this small percentage would justify a radical departure from present practice. Moreover, direct experiment would be necessary to show that the saving would come out on the right side.

In the case of a steam relay, a small steam cylinder has to be added to work each valve, and from the nature of such contrivances it is impossible to use steam economically therein. The work has, in the case of an ordinary engine, to be done by expending a certain amount of power developed economically by the use of steam expanded many times in the same engine. The efficiency is, however, reduced by transmission through eccentrics, rods, etc. In the case of a steam relay the actual work to be done by the steam exceeds that necessary to actually move the valve by the amount required to overcome the friction of its own piston, and possibly also by the friction of an extra stuffing box.

In both cases we have the same work to be done at the valve. With the steam relay the loss of transmission is small, but the steam is uneconomically used, the consumption being comparable to that of the smallest and least economical type of engine. In the mechanically moved valve a greater loss in transmission occurs, but the steam is used economically.

Without pretending that the following figures are more than rough approximations to truth, they are probably near enough to help us in forming a first judgment. Suppose a valve absorbs 1 horsepower in friction. We may assume that a further loss in friction with a mechanical valve gear would amount to from 1 to 2 H.-P. Supposing that the consumption of the main engine is 25 pounds of steam per B. H.-P. per hour, then from 50 to 75 pounds of steam per hour would be used in operating the valve and its mechanism. With a steam relay cylinder we may assume that in addition to the I. H.-P. for the valve ¼ H.-P. is absorbed in piston friction, probably leakage may be put down as increasing the consumption to an amount equivalent to that needed for an additional ¼ H.-P.; the work to be performed is therefore from 1¼ to 1½ H.-P., as against from 2 to 3 H.-P. for the mechanical system. It is difficult to accurately estimate the steam consumption of the relay cylinder per H.-P. per hour, but basing one's estimate on the well-known results of small engine trials, the best result one could expect would be about 50 pounds of steam per I. H.-P. per hour. The cost on this system would therefore be from 62½ to 75 pounds of steam per hour as a minimum.

Under the circumstances it seems somewhat improbable that economy will be gained by adopting this system, as there must still be a certain proportion of power to supply the current needed to work the valves of the relay cylinder electro-magnetically. Mechanically considered, there are many points which justify a rational scepticism as to the simplicity claimed. For every valve moved there must be a relay cylinder, a small valve and either two electro-magnets or solonoids, one magnet or solonoid and a spring, or its mechanical equivalent. There must be a generator of current for the system, and a supply of current must be available when the engine is stopped, or there must be auxiliary gear for working the valves at starting. There must be rubbing contacts and quite a nice little nest of leads. These must be carefully guarded from steam and oil, both not unknown to engine rooms, and the magnets, although near enough to the relay cylinder to avoid long mechanical connections, must yet be insulated from the heat radiated by it, if the magnet windings are to be properly preserved. The attraction between the pole faces of an electro-magnet and its armature rapidly falls off as the distance between the two increases; as the greatest resistance of a valve's motion is in starting, and as this coincides with the position of least attraction the magnets must be of a size far larger than would be necessary to perform the average work of moving the valve of the relay cylinder, and a cushion must be provided to prevent excessive knocking, as in the case of the dashpot in Corliss gear. Owing to this fact it would appear very doubtful if attempts to supplant the relay cylinder by direct-acting magnets would improve the economy of the system, while the extra size of the magnets and current generator would be a set-off to the saving in the first cost due to the absence of relay cylinders.

It would be interesting if reliable figures could be obtained of the power expended in operating the valve gear of a Sulzer engine. It is impossible to conceive of any great inefficiency in the gearing between the crank shaft and the levers lifting the valves, while magnets to do the same thing would involve large amounts of wasted energy, owing to the variation of the force of attraction on the armature noticed above.

Moreover, it must be remembered that in operating a valve by a magnet the current must be of such strength that the valve may work with a margin of certainty under the worst conditions of lubrication. Hence the normal current strength must be very largely in excess of that needed for working the valve under ordinary conditions. But with a mechanically driven valve extra resistance only implies the expenditure of extra work in overcoming friction while the maximum demand exists, the loss of energy being confined to actual requirements at all times.

In addition to this, the necessary losses in conversion of mechanical to electrical energy and the heat losses of the circuit have to be reckoned with. On the score of reliability little can be said, there being no inherent reason why electric valve motions, after due time has been allowed for the process of natural selection to weed out imperfect schemes, should not be as reliable as other methods. On the whole, there seems little promise of any startling revolution in economy or convenience. And it may be doubted whether for transmission of motion for such limited distances mechanical movements, pure and simple, can be beaten.

The place where electrically controlled relay systems promise well are those where remoteness and inaccessibility lend advantages to the method which are offered by no others. The control of railway signals is a case in point. ROBERT A. BRUCE.

New Brompton, England.

Hardening Steel.

Editor American Machinist:

Your note in issue of August 3, concerning the hardening of tool steel without discoloring or oxidizing it, reminds me of a valuable hint I got from an old "jour" in my apprentice days. The method then learned to insure a perfectly clean surface should not be kept a secret. The material used is common soap, and it may be applied either before heating the article or after heating it enough to cause the soap to flow, which is a very low heat indeed. The latter mode is to be preferred; then proceed in the common way of hardening.

The soap so applied will cover the steel with a very thin coat, which remains there until immersed in water, when it will wash off, or if a little should remain, it can be cleaned with waste. The color of the steel is perfectly white and the surface absolutely clean.

While speaking about hardening, assuming tools of the various kinds, there are still other articles requiring a distinct treatment of their own, such as springs. This branch of hardening requires a lot of patience and experience. There are, nowadays, quite a number of steels known as spring steel, each varying from the other in composition, and each fitter for one purpose than the other, and, in general, each brand requires its own peculiar treatment. However, tool steel will

make excellent springs, it being well suited to attain and maintain the highest degree of elasticity. Most machinists and blacksmiths have their own particular treatment for hardening steel. Some use oils, others lye, etc., etc. In hardening, all that is really necessary is to give the steel such a degree of hardness as will render it suitable for its purpose. This, unfortunately, cannot be done at one operation, but must be accomplished by drawing the temper after the hardening, and a good spring has a very low temper; or, better said, it is one of the softest of hardened articles. I made a spring some years ago, when I got a lesson as to how to harden a spring, and, what is better, I often used that instruction; and it never failed with any kind of steel, tool steel being the best, the others requiring "a getting acquainted." It requires nothing but a little patience. After the spring has been evenly heated, immerse it in cool water until the water will remain upon it—that is, not steam off. Next hold the spring over the fire (charcoal being the best) until when a dry piece of soft pine is drawn across it sparks will fly freely. It is then necessary to cool the spring at once. The heat of the spring is high enough to show dark red if held in a very dark place. The springs so treated will be ready for use, and, as a matter of fact, you may guarantee them. If the steel is spring steel, which has to be heated in order to shape it, it may be necessary to repeat the process of drawing the temper as described above. While in Brooklyn I had to make some springs for the strippers of dies, which broke the first day; but after I made the second lot they stood the racket for more than three months. That is, after three months the dies required repairing, while the springs showed no sign of use, although they were in use every day.

E. LAWRENZ.

A New Wabble Drill—Use of Draftsmen's Curves.

Editor American Machinist:

Some years ago there was given in the "American Machinist" a description of our method of chambering the bottom of holes, where they are to be tapped, so as to get better results.

I am so frequently called upon to make sketches and describe the plan, that it will not be amiss to again illustrate it, especially as another arrangement has been schemed whereby the device can be used to special advantage.

Fig. 1 shows the wabble drill we invariably use when holes are to be tapped that do not go through the castings. The shank is fitted to a Beaman & Smith tapping attachment, and, as will be seen, the shank is of such form that the point can wabble to a limited extent. Fig. 2 shows its position when entered in the hole, and Fig. 3 when the hole is finished. The improvement is shown in Fig. 4. If it were easily possible to drill all the holes of the same depth, then the drill, as shown in Fig. 1, would need no improving; but in tapping for studs it is desirable to have them all go to a positive depth, so that they can be cut to length and come right. By using the drill as shown in Fig. 4, the bottom of the recess will be at a fixed distance below the face of the casting, and studs of a fixed length may be used with a certainty that all will project alike.

In the use of the Beaman & Smith tapping device we have a reverse motion of drill spindle for backing out, and as the backing motion has twice the speed of the forward, we use left-hand drills for small holes, and so make time.

Fig. 1

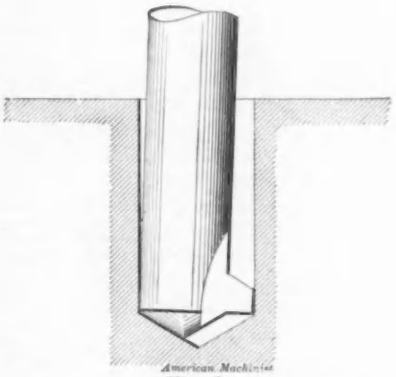


Fig. 2

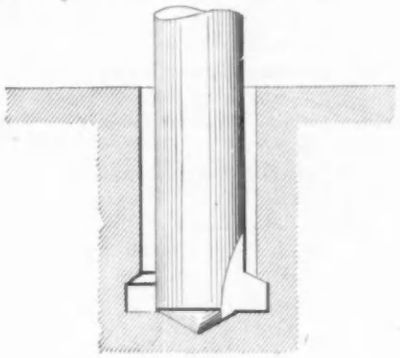


Fig. 3

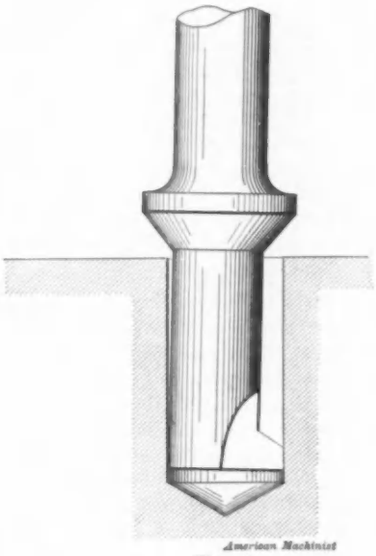


Fig. 4

A NEW WABBLE DRILL.

I see by the last number of the "American Machinist" that Mr. Drues puts in his protest against the use of French curves, and I can only wonder what such firms at William Sellers & Co., such designers as John Richards, and firms and designers who have built up a reputation as designers, think of that proposition. I can understand how shapes can be approximated by pieces of circles, and that when these are put in the hands of an artistic pattern-maker the result will be all right; but I doubt if, in the end, the curves are not such as no circle will fit. One might as well try to carve a statue to fit circles as to make a graceful machine design in that way.

If the pattern-maker will duplicate the draftsman's curves, he can apply them to his pattern drawing or patterns much more readily than he can locate compass centers, which often fall outside and require some temporary cob-house structure with several trials to fix. I have found these curves simple things to make. Thin strips of pine are always available in the pattern shop, and one with the two limiting points fixed can, with draw and spoke shaves, work out a good shape in short order.

In your answer to inquiry No. 72 you advise running the carriage by a scale to even inches, with all even number master screws, and in cutting threads of even numbers, even half inches will do as well. That is to say, in cutting a thread 2¼ inches long it is necessary to run back 2½ inches instead of 3 inches, as your answer would imply.

JOHN E. SWEET.

That Gasoline-Electric Truck.

Editor American Machinist:

In issue of "American Machinist," July 27, page 694, I read with interest an account of a new heavy automobile truck

that is going to be made by somebody or other, soon. I am keen for more information about that truck, with its gasoline engine to drive a dynamo to charge accumulators to drive a motor to drive gearing to drive the truck.

It's like the fellow who was so lazy that he walked five blocks and a square to take a car to drive to the fire station to get a fire escape to land him on the roof of his seventeen-story abode to get through the skylight to walk down the stairway to get to his store on the ground floor, in preference to entering from the sidewalk by the main door like common folks, who have to have sense.

That cylinder, too! It gets hot! Of course it does, and my impression is that it will get hotter and hotter, if only with indignation at the way in which its power-transformation is (going) to be made to advertise for a fool-killer. Still, it has one great recommendation, viz.: it hasn't been made yet. Then those accumulators that are (going) to weigh about 1,000 pounds, and store an excess of the available power—which is going to be shoved by that 12 horse-power engine into those 1,000 pounds of accumulators—sufficient to drive that truck that is (going) to weigh up to 9½ tons, loaded, up great big steep hills or through four or five miles of thick road, all on its little very own.

Personally, I don't believe those accumulators will ever accumulate worth a cent, nor that truck truckle any at all, because there is going to be one little tiny error in the specification that is going to about upset all the calculations. I refer to that hand wheel and rack and pinion steering, which is going to be retained, as it is (not going to be, this time, it *is*) perfectly satisfactory. I submit that this is not possible under the circumstances. That hand wheel needs to be slung on a thin copper wire or a piece of string, with two right-angle pulls at the back of the truck, and connected by a rope and sheave hoist to a good block and chain tackle, actuated by a donkey engine and windlass, the winding drum being clutched to a worm and wheel arrangement to deflect the steering wheels. That's all that wants. This system has the disadvantage of being somewhat heavy (and I don't forget that it is of the first importance in motor-cycle designing to keep weights at the lowest possible figures), but in the event of the gasoline engine (four cylinders, four cycle), or the dynamo or the accumulators or the motor or the gearing of the truck breaking down, the donkey engine and drum could be detached from the steering—taking care to hang that hand wheel up somewhere carefully, well greased to avoid rust—and by attaching the chain and rope tackles to handy lamp-posts, sewer gratings, or policemen, the truck could be warped back to its stables in easy stages, without requiring excessive skill or labor.

The heavy automobile is as yet an unsolved problem, and the behavior of this rebuilt truck will be watched with much interest.

J. H. BALL.

Barcelona, Spain.

P. S.—Nothing is said about there going to be a brake on the machine, but possibly the truck will not require one.

Management of Light for Hardening Steel—Color Comparisons.

Editor American Machinist:

Some of your correspondents seem to be grappling with the question as to what we shall name the heat color at which tool steel hardens, one claiming that "cherry red," the conventional name, is indefinite, and suggesting "blood red" instead, which would seem to be a doubtful improvement. Another correspondent, E. H., in issue of May 4, suggests having slips of paper of the proper color for each brand of steel. This suggestion seems to have some value, although when we consider the probability of the paper changing color through handling, or from other causes, it does not appear to quite meet the requirements. A point that should be kept in view is that anything in the way of a color guide, to be of value, must always be seen in the same light; and also be capable of being brought close to the work in the fire for comparison, two things that are somewhat antagonistic, and, taken together, difficult to attain practically. The arrangement that I would suggest would be a pane or window of properly colored glass set in a north wall, facing the operator. A second choice would be a sheet of properly colored tissue paper placed under the same conditions. The latter plan would be the easiest to carry out, and by frequently changing the tissue paper, would probably answer the purpose. In either case all white light should be excluded from the room.

I believe that this matter of the regulation of the light in the hardening room does not generally receive the consideration that it should. Just what the practice of others may be I do not know, but I prefer to have the room darkened to a sort of twilight, experience convincing me that for my particular work at least I get the best results with the least amount of eye fag in this sort of light; but whether we have the room light or dark I believe we will obtain the best results by working always under the same conditions as far as possible. All are agreed, however, that steel should be brought to a certain red heat, and whatever name we apply to that heat color, and whether we obtain it in a coal or coke fire or in a gas furnace, the regulation of the heat of the fire or furnace, and the proper heating of the steel, will all depend primarily upon the ability of the eye to determine when the desired heat color has been reached. It is not a matter merely of seeing the color of the piece in the fire, but rather the distinguishing of that color among a number of similar varying colors, the highest or brightest of which will have the greatest effect on the eye, tending to obscure or weaken its capacity for detecting the color desired. It is because of this brighter color or glare of the fire, which must always be present in order to bring the work to a proper heat, and its effect on the human eye, that reliable steel hardening is as difficult as it is; and to my mind we add very greatly to this difficulty when we undertake to heat the steel in an open fire in a light room, or just after making a weld.

This blinding effect of light on the human eye is a matter of common experience, and that the capacity of eyes to de-

(*Continued on page 39.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

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Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

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Factory to Let—Elizabethport; rail and water; all improvements; 60 windows; size, 150x50; engine; 12 city lots with factory. Address Mr. Coote, Elizabeth, N. J.

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For Sale—Belt-driven compound air compressor, lately built by standard makers; nearly new; prime condition; total low pressure piston displacement per revolution, 1,100 cubic inches; good for any pressure below 400 pounds; straight-line construction, self-contained on bed. Address "Norfolk," AMERICAN MACHINIST.

Wants.

Situation and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisements under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants

may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

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Tool-maker, 14 years' experience on general tools, combination dies and fine experimental work. Box 237, AMERICAN MACHINIST.

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Foundry foreman desires position; experienced on engine, machine tool and general jobbing; can give A1 ref. Box 226, A. MACH.

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Mechanical engineer, graduated, with experience in different branches, also well up in languages, wishes position in New York City; salary no object. Box 227, AMER. MACHINIST.

Position as superintendent, assistant or master mechanic in manufacturing concern; thorough experience in plant construction and operation; technical graduate; would invest some money. Box 222, AMER. MACHINIST.

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Position Wanted—As factory superintendent or master mechanic, having held similar position for past 6¼ years; good mechanic; understands piece-work system thoroughly; best of references. Apply Box 217, A. MACH.

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Wanted—Position as manager or superintendent, in America or Europe, by an American who has had experience in organizing and systematizing, also in cutting costs, and is conversant with first-class shop practice; correspondence solicited. Address Box 244, AMERICAN MACHINIST.

Help Wanted.

Wanted—A machinery salesman to sell for an old-established machinery manufacturer; in reply give age and experience. Box 234, AMERICAN MACHINIST.

A good mechanical draftsman wanted for a position in the country. Address, stating experience, age, references and wages expected. Box 230, AMERICAN MACHINIST.

Wanted—A competent operator of a Jones & Lamson flat turret lathe, also a man to operate emery polishing wheels, by Taunton Locomotive Mfg. Co., Taunton, Mass.

Machine tool designer, thorough draftsman; excellent opportunity; salary according to ability; give age, experience and references. Address P. O. Box 88, Cincinnati, O.

Wanted—An active and energetic man, about 30 years of age, for installing machine tools in a large plant now being built; give full particulars. N. Y. S., AMER. MACHINIST.

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Wanted—Thoroughly competent man to take charge of machine shop for the finishing and assembling of marine engines; write, giving age, experience and salary expected; confidential. Address Lock Box No. 1042, Philadelphia, Pa.

Wanted—Machinist accustomed to erecting engines and pumps; will be required to erect machinery where it is used away from the shop; with application state wages per hour and give reference. Address Box 232, AMERICAN MACHINIST.

A man to make estimates for a shop engaged in light contract work; competent machinist preferred; must have worked in a prominent shop in a similar capacity; state age, experience, references and salary required. Box 231, AMERICAN MACHINIST.

Wanted—Competent field foreman for erecting pen-stocks, water towers, tanks, steel stacks, etc.; man must be expert at handling men and rigging; monthly salary and no lost time to right party; write full particulars. Struthers, Wells & Co., Warren, Pa.

Wanted — Expert draftsman, technical graduate, familiar with complicated mechanical movements, to transfer fully designed sketches to Patent Office boards; must have finished execution and ability to reproduce in miniature. Address Engineer, P. O. Box 53, Seabright, N. J.

Wanted—First-class man, not over 45 years of age, as superintendent of an old-established manufacturing concern, located about 50 miles from New York City, employing 500 people, engaged in brass goods manufacturing; must understand modern factory methods. Apply by letter to Box 214, AMERICAN MACHINIST.

Draftsman and designer wanted at once; a man who is used to special machinery, and is capable of carrying the work along rapidly and at the lowest cost in the machine shop; this is a good position for the right man; send age, pay expected, experience and references; also good machinists wanted. Address Box 242, AMERICAN MACHINIST.

Wanted—A thoroughly informed toolmaker, not only up on small tools, but understands handling lathes, planers, etc., and knows their maximum capacity; must be familiar with modern methods and have practical ideas; to take position as assistant foreman when sufficiently acquainted with work. Box 225, AMERICAN MACHINIST.

Wanted—A superintendent in an established plant employing about 100 men, manufacturing a machine similar to typewriter; applicant must have large experience in modern approved methods of producing interchangeable parts; a liberal salary will be paid to a thoroughly capable person, who must come well recommended. Address Box 241, AMERICAN MACHINIST.

Wanted—Experienced lathe, planer and vise men, also several men and boys who have done more or less machine work, by a high-grade machine tool company located near Milwaukee; shop is new, fitted with all modern conveniences, and is strictly up to date in every particular; steady work and opportunities for advancement to the right parties; write, stating wages expected, experience, age, etc. Box 221, AMERICAN MACHINIST.

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High Grade Machine Patterns Our Specialty.
Send Prints for Estimate.
F. W. GRAHAM MFG. CO.,
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(*Continued from page 38.*)

tect certain colors varies is equally well known. We know also that the eye gets tired, and is affected more or less by the physical condition of its owner. Taking all this into account, it would seem that we ought to surround the eye with such conditions as will enable it to work with the greatest certainty and least possible amount of fatigue.

Joliet, Ill. WALLACE L. HARDY.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer by mail.

(78) I. T., St. Johns, N. B., asks: (1) How long does it take one gallon of liquid air to evaporate when it is properly protected by felt or other heat insulating material? A.—We are reliably informed that a single gallon of liquid air may be kept for more than twenty-four hours, while in quantities of ten gallons it will take three or four days to evaporate it all. (2) What is the nearest place to St. Johns, N. B., where liquid air may be obtained? A.—New York city. So far as we know this is the only place where liquid air is produced in commercial quantities.

(79) H. C. asks: Is there any standard diameter given to pipe taps; say, for instance, a 1-inch pipe tap 11½ threads per inch; what will be its diameter at the small end? A.—What is known as the Briggs standard specifies the diameter of the threads (top and bottom) at the end of the pipe, the taper per foot (¾ inch) and the length of full or complete threads. These are as follows:

Nominal inside diameter.	Number of threads per inch.	Length of perfect screw.	Dia. of bottom of thread at end of pipe.	Dia. of top of thread at end of pipe.
Inch.	No.	Inches.	Inches.	Inches.
⅛	27	.19	.334	.393
¼	18	.29	.433	.522
⅜	18	.30	.567	.656
½	14	.39	.701	.815
¾	14	.40	.911	1.025
1	11½	.51	1.144	1.283
1¼	11½	.54	1.488	1.627
1½	11½	.55	1.727	1.866
2	11½	.58	2.2	2.339
2½	8	.89	2.62	2.82
3	8	.95	3.241	3.441
3½	8	1.00	3.738	3.938
4	8	1.05	4.235	4.435
4½	8	1.10	4.732	4.932
5	8	1.16	5.291	5.491
6	8	1.26	6.346	6.546
7	8	1.36	7.34	7.54
8	8	1.46	8.334	8.534
9	8	1.57	9.39	9.59
10	8	1.68	10.445	10.645

Of course, the tap must be somewhat smaller at the end, in order to make the fittings clear the end of the pipe. That is to say, the diameters given must be at a

point some little distance from the end of the tap, but we think there is no standard for this, but that it is left to the tap-makers.

Inquiries for Machinery.

Those who make or may know of the makers of such machinery as is called for below, will oblige us by sending name and address, mentioning the number of the inquiry. We cannot forward catalogs. We have inquiries as follow:

(108) For makers of chilled iron lathe and planer tools.

(109) For a machine to cool sorghum by an air blast instead of by water.

Personal.

Thomas Galley has been appointed assistant manager of the works of the Warder, Bushnell & Glessner Company at Springfield, Ohio.

Ralph A. Gleason, formerly assistant superintendent mechanical department, Maryland Steel Company, is now chief draftsman Goodson Graphotype Company, New York City.

Obituary.

Alexander Bradley, founder of the stove-manufacturing firm of A. Bradley & Co., died at Pittsburgh, Pa., August 21, eighty-seven years old. Mr. Bradley was born in Baltimore, Md. He was first an apprentice in the foundry of W. T. McClurg, and later became a partner in McClurg's Franklin foundry. The firm of A. Bradley & Co. was founded in 1845.

Seneca M. Richardson died at Worcester, Mass., August 15, sixty-nine years old. He was born in Corinth, Vt.; learned the machinist's trade, and located in Worcester in 1860. In 1864 the widely-known firm of Witherby, Rugg & Richardson, manufacturers of wood-working machinery, was established, Mr. Richardson superintending the shops and the mechanical details. He was active in business up to the time of his death.

The official report on the mineral production of the United States for 1898 has just been made public, and shows that since 1880 the total value of the mineral production of this country has increased from $369,319,000 to $697,880,002 in 1898, nearly 90 per cent. The normal increase deduced from this record of nineteen years is at the rate of $18,000,000 annually, but in the five years since 1893 the rate of increase has been nearly $25,000,000 annually.

Regarding the process for hardening tool-steel articles, about which we published an item in our issue of August 3, and which was claimed to have been originated by Mr. Janney, of the Trinity Cycle

(*Continued on page* 41.)

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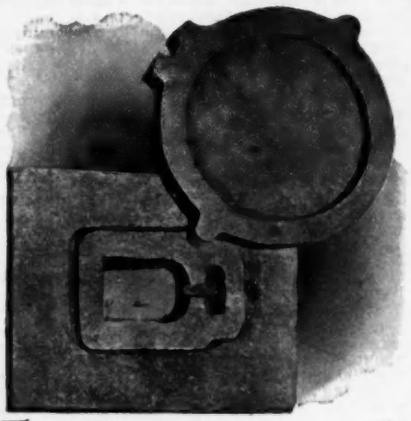

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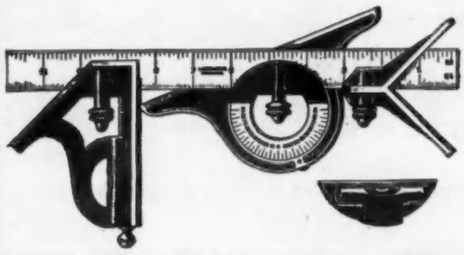

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SECOND-HAND. CONDITION A1.
One 33 inch x 33 inch x 8 foot Planer. New.

Woodward & Powell Planer Company,
Manufacturers of Metal Planing Machines,
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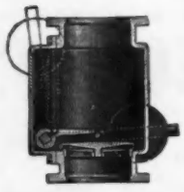

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This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments.

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A Study of the Principles which Underlie the Mechanical Engineering of a Power Plant. By FREDERICK REMSEN HUTTON, E.M., Ph.D., Professor of Mechanical Engineering at Columbia University. 559 pages. 8vo, cloth, $5.00.

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Hugo Bilgram, Machinist,
440 N. 12th St., Philadelphia, Pa.

(Continued from page 40.)

Company, Mr. Ethier, to whom we first credited the process, writes that, as a matter of fact, he discovered the method in 1896, when he was employed by the Humber Company, in Westboro, Mass., and that it was not in use at the Trinity Cycle Company's shop until he went to work there. This seems to be a question of veracity between the two gentlemen named, and we do not undertake to decide between them.

A press dispatch states that Vickers' Sons & Maxim, Ltd., at their shipbuilding works in Barrow have fitted up the old "Alaska," which at one time was the fastest of the Atlantic liners, as a boarding house for the workmen, many of whom will sleep and eat aboard of her. The dining, reading, smoking and recreation rooms, the promenade deck and baths will be at their disposal. Food of the "best quality" will be supplied, and the cost to the men will be about $3.30 per week.

Manufacturers.

The Somerset Fibre Company, of Fairfield, Me., will build an addition to its pulp mill large enough to double the daily capacity.

The N. O. Nelson Foundry Company, of St. Louis, are locating at Bessemer, Ala., a casting plant for sanitary pipings and supplies.

The Pilling Manufacturing Company, Philadelphia, Pa., has had plans prepared by William Steele & Sons for a brick addition to its factory.

The Union Metallic Cartridge Company, of Bridgeport, Conn., has placed an order with the Berlin Iron Bridge Company, of East Berlin, Conn., for an extension to its factory.

Ground was broken recently for the new plant of the Pennsylvania Malleable Steel Company, at McKees Rocks, Pa. The new mill will be in operation next spring, and will employ between 700 and 800 men.

Ground was broken recently by the Chicago (Ill.) Malleable Castings Company preparatory to beginning the constructon of an extensive new plant at West Pullman on 7½ acres of land recently purchased from the West Pullman Land Association.

Contractors Ryan & Kelly, Broad and Market streets, Philadelphia, Pa., have received the contract for the sinking of piles and constructing the foundation work for the power house to be erected at Baltimore, Md., for the United Railways Company, of that city.

Jas. Clark, Jr., & Co., Louisville, Ky., have commenced work on a new brick machine shop. This will be 75x100 feet, with annex for boiler and engine room. An electric traveling crane will be installed, and all tools will be driven by independent electric motors.

A building permit was issued recently for the rebuilding of the plant of the E. & N. Manufacturing Company, Nashville, Tenn., which was destroyed by fire some weeks ago. The new building will be of brick, and will cost $10,000. It will be 250x60 feet, and will be four stories high.

A large manufactory is promised for Cumminsville, Ohio. Architect George W. Rapp is at work on the plans for the building, and bids for its erection will be opened very soon. The structure, which will have a frontage of 310 feet on Spring Grove avenue, near Hopple street, is for the Blymyer Iron Works.

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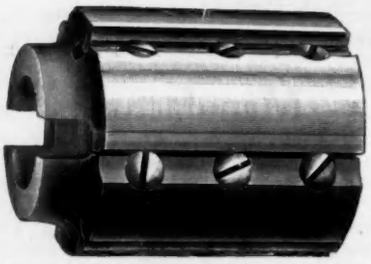

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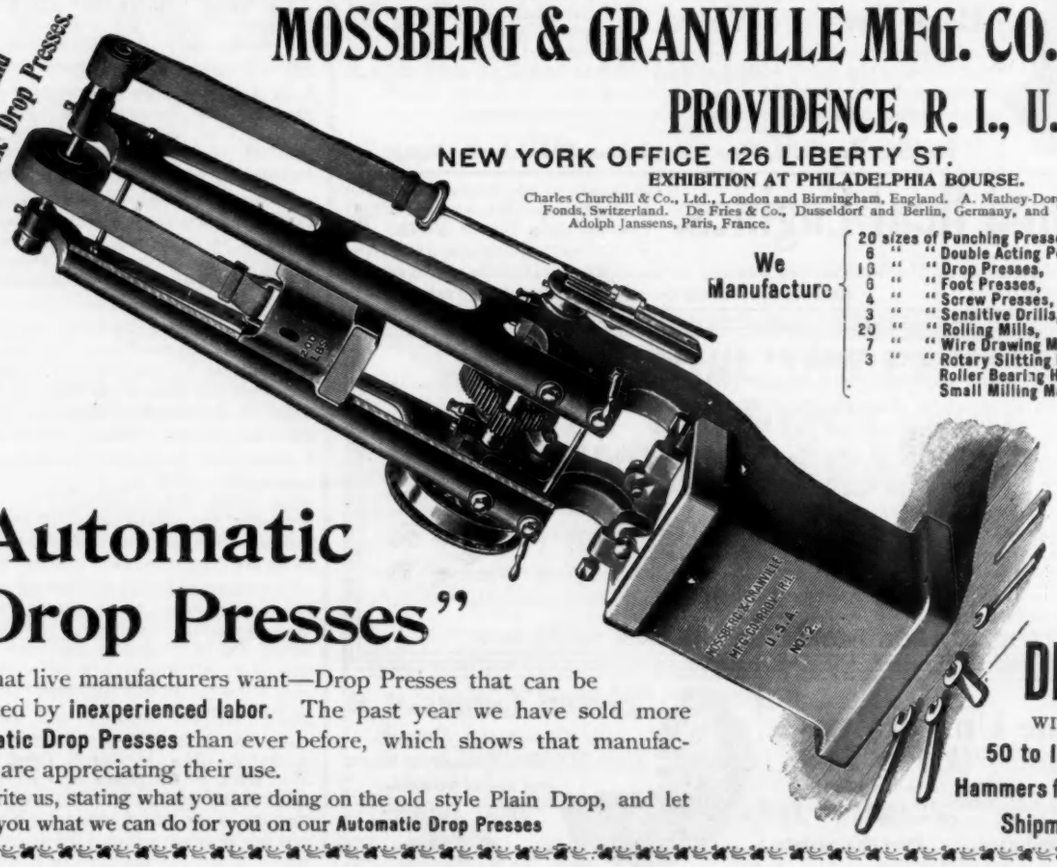

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